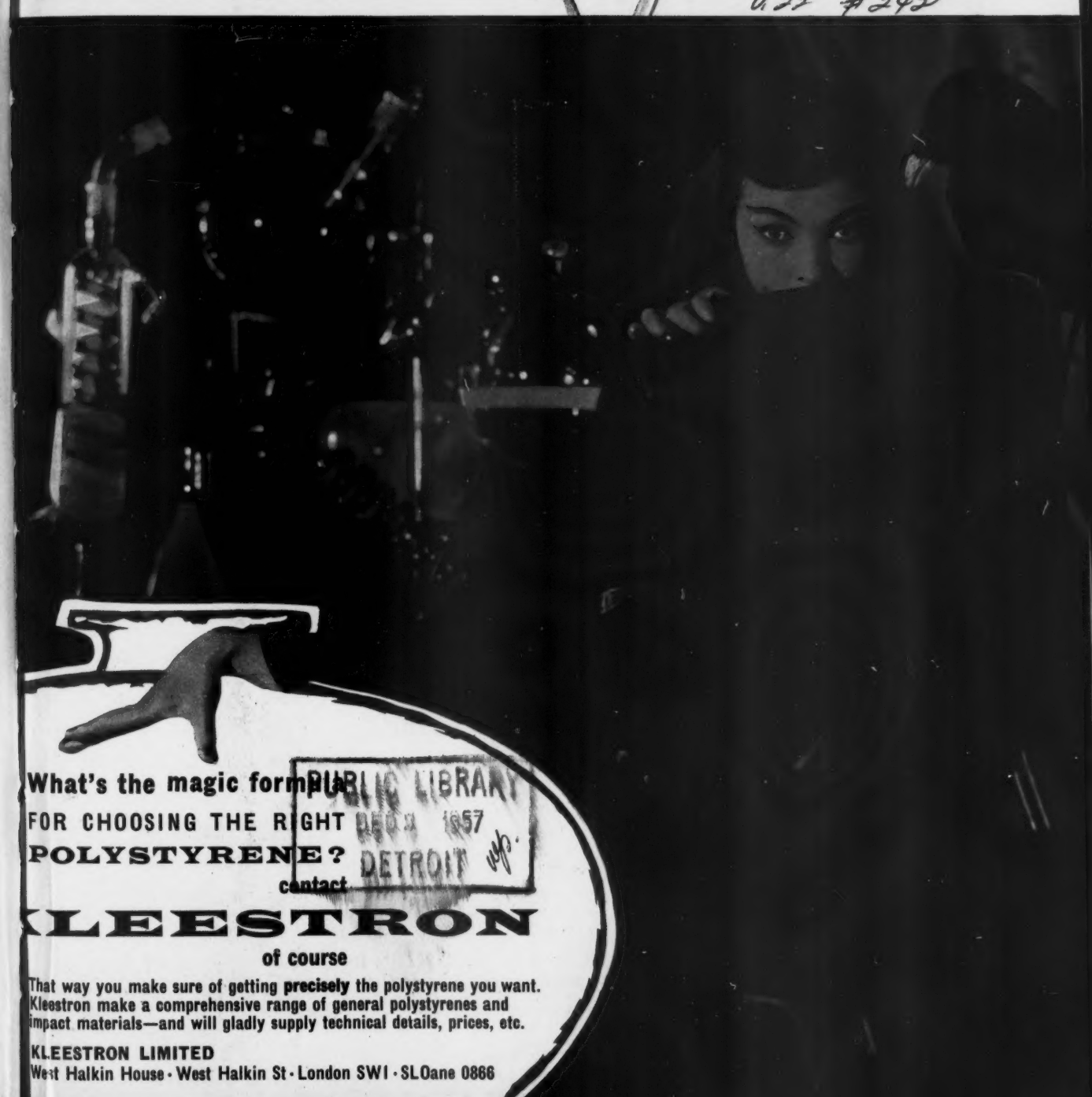
CHNOLOGY DEPT.

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

U22 #242



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FOR CHOOSING THE RIGHT
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That way you make sure of getting **precisely** the polystyrene you want. Kleestron make a comprehensive range of general polystyrenes and impact materials—and will gladly supply technical details, prices, etc.

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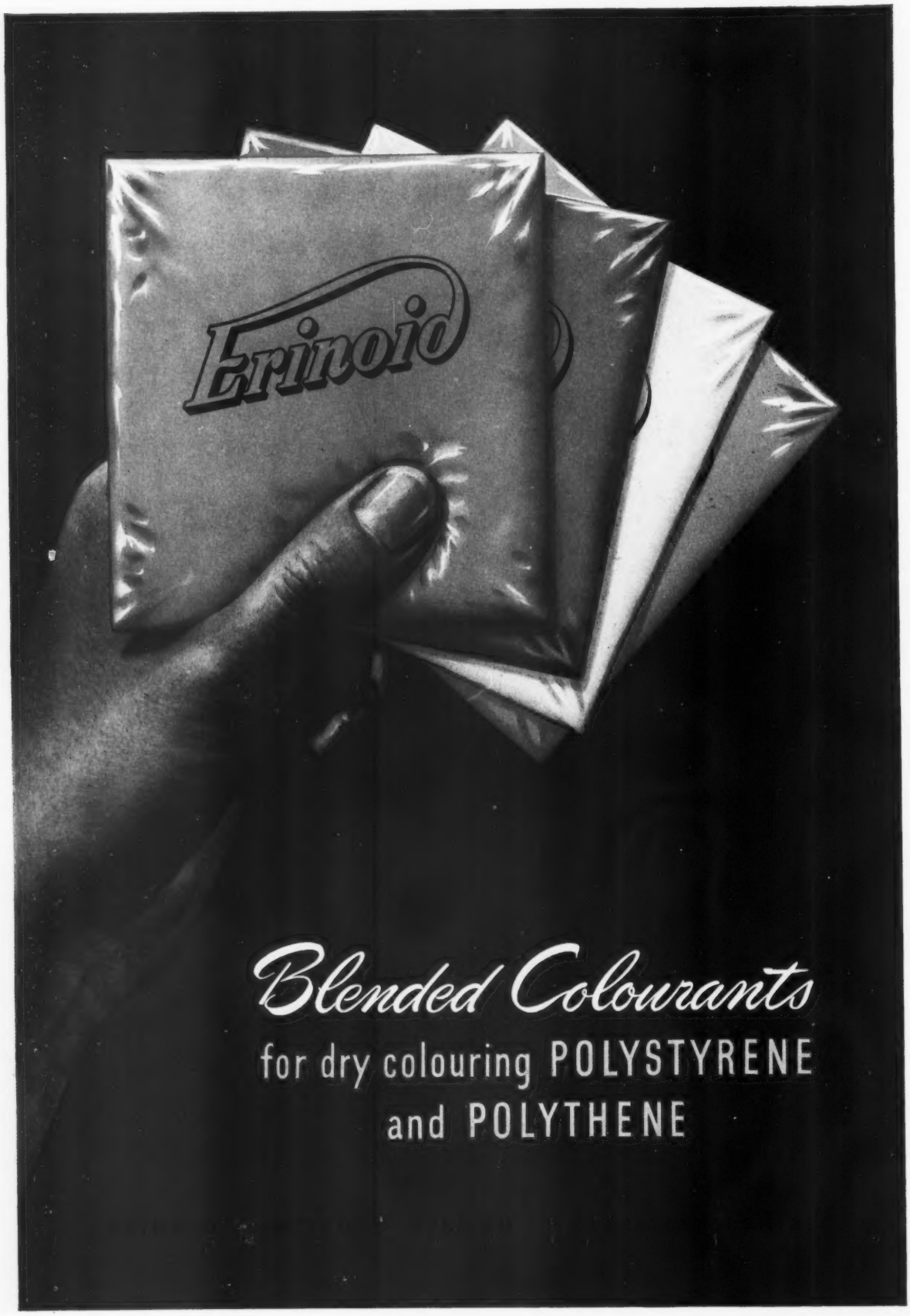
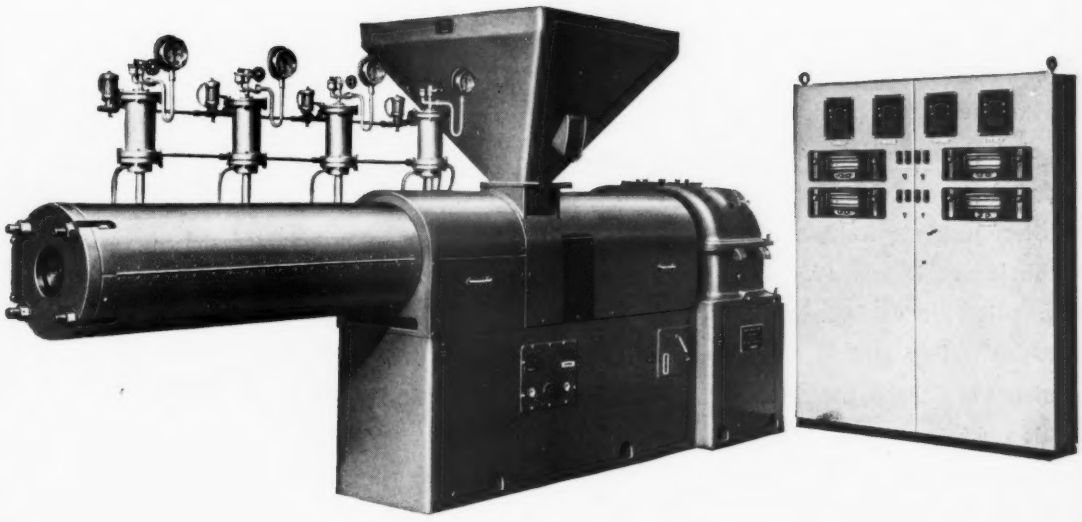

Erinoid
Blended Colourants
for dry colouring POLYSTYRENE
and POLYTHENE

EXTRUDERS AND PLANT FOR THE PLASTICS INDUSTRY

descriptive folder sent upon request



This Extruder, built completely in our works has a 6" diameter screw 16 diameters long and is fitted with the "Willert" Patent Vapour Cooling System and panel with electronic controllers. This system completely eliminates problems of overheating due to excessive frictional heat. It is entirely automatic and has no moving parts. There is no need for the operator to determine whether cooling should be "on" or "off". We build Extruders in all sizes from 1½" to 8" diameter with screws up to 24 diameters long.

Bone Brothers Ltd

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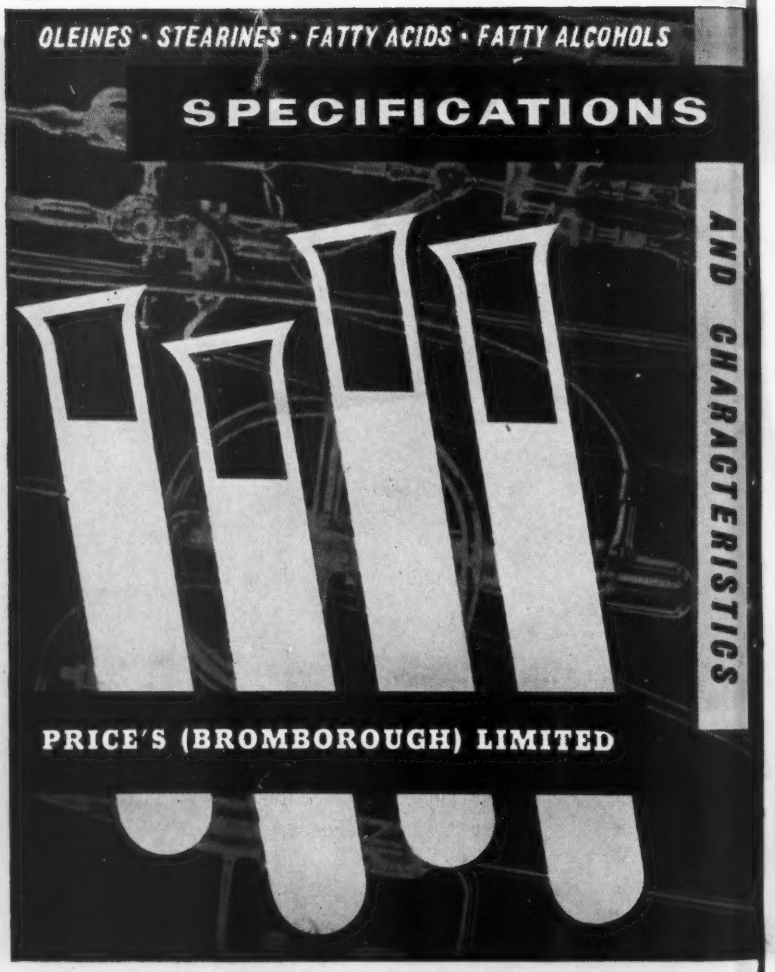

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TY-ROCK

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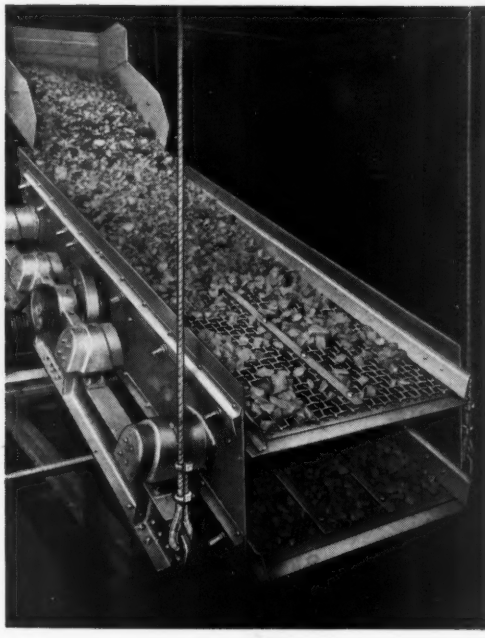

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Ty-rock Screens are made in a range of sizes for wet or dry screening — one, two or three decks. Write for full details.

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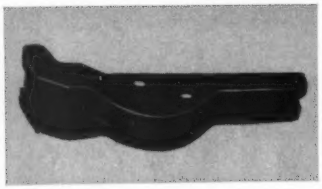
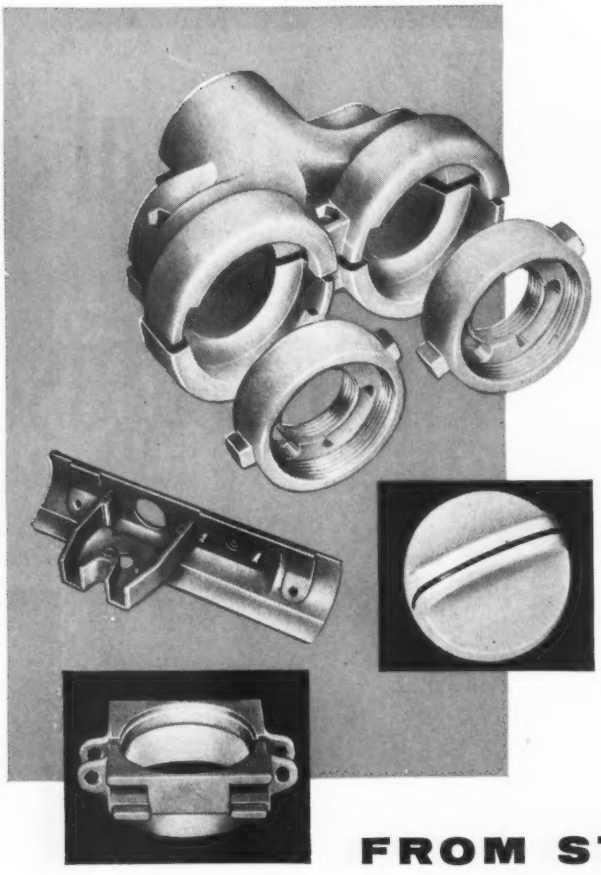
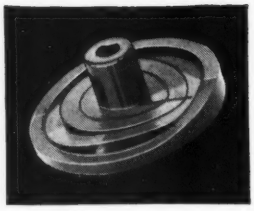


FOR ALL

COMPRESSION MOULDINGS





The almost limitless range of mouldings we make and the diverse problems we solve are matched by the speed with which orders are delivered.
What is more, we can proudly claim that every stage of the process is 'ours all ours'. From your blue prints we design and make the tools, and our craftsmen, aided by the most up-to-date precision equipment, rapidly carry out complete production. All of which explains our reputation for turning out a first class job at a competitive price.

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If you have a plastic moulding problem consult us right away. We KNOW we can help you.

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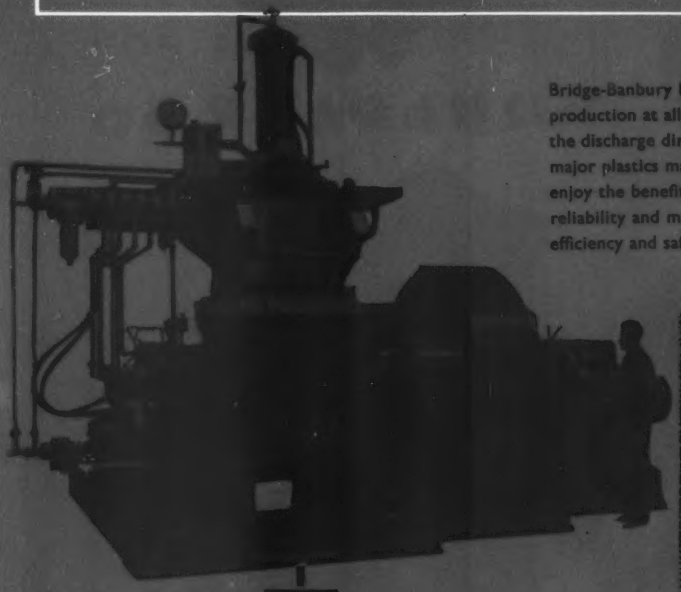
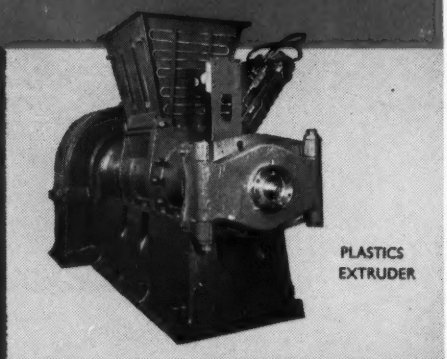
Smee's R111

Bridge-Banbury *Automation*



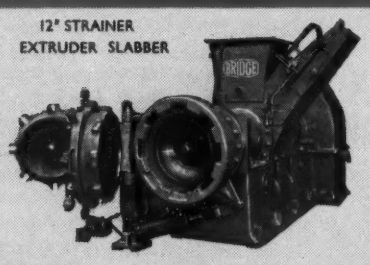
Bridge-Banbury Extruder Systems give a continuous even flow of production at all times. These matched units are designed to take the discharge direct from the Bridge-Banbury. Many major plastics manufacturers throughout the world enjoy the benefits of high quality production, maximum out-put, reliability and minimum labour costs with the maximum efficiency and safety provided by BRIDGE-BANBURY Installations.

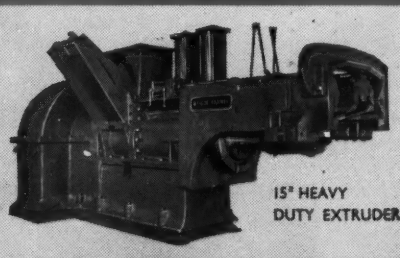
SIZE 11 BRIDGE-BANBURY



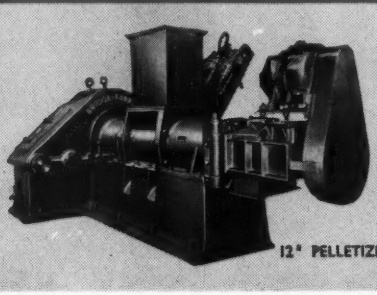
PLASTICS EXTRUDER

12" STRAINER EXTRUDER SLABBER





15" HEAVY DUTY EXTRUDER



12" PELLETIZER

Vital links in Bridge-Banbury *Matched Production Units*

There is a wide range of special purpose Extruders for every application and a great variety of stocks for matched production with every size of Bridge-Banbury mixer.

For many years we have made a speciality of engineering complete processing set ups, comprising production machines matched in capacity to prevent "choking" or "starving" of succeeding units. Production flows without costly interruptions with manual aid and supervision reduced to a minimum.

Our engineers are ready to assist in working out the best arrangement to suit individual requirements.

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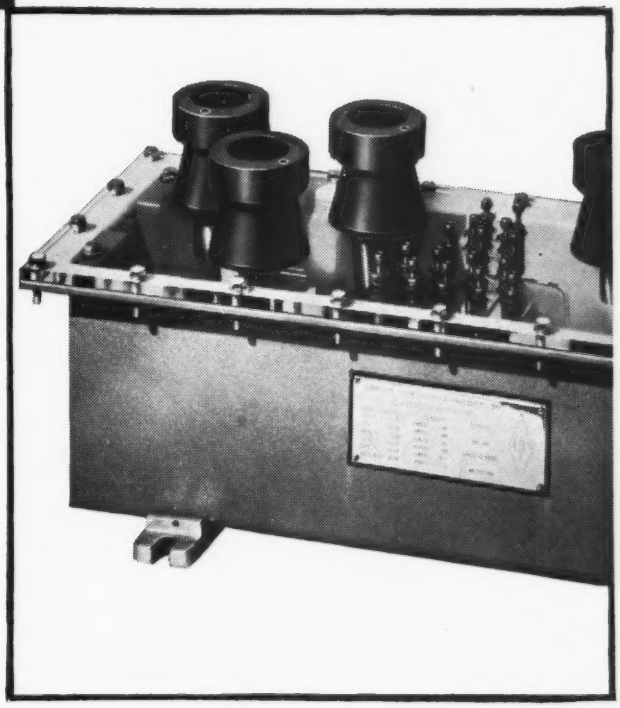
These valve holders, made by London Transformer Products Ltd., have been developed because of the great difficulty experienced in effecting a completely oil-tight seal on standard valve bases when mounted on oil-cooled transformers. The problem required a material which would withstand high working voltages under adverse conditions of service.

FOUND: *Epikote Resins with the necessary qualities*

Yes, excellent adhesion, excellent electrical and mechanical properties. Low shrinkage on cure. High resistance to heat, water and chemicals. L.T.P. Ltd. selected "Epikote" resin 828 as giving the most satisfactory results. The valve bases were required to withstand a peak breakdown voltage of 25KV under conditions of high humidity. On test a figure of 38KV peak breakdown voltage was obtained; the resultant equipment therefore had a very much higher factor of safety in operation.

The technical resources behind the Shell organisation will work in close co-operation to solve your production problems by the use of "Epikote" resins.



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unrivalled for potting and casting

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Transparent acetate film with a sparkling success. Clear as crystal for packs that stop the shopper's eye . . . smooth as satin for colour-rich laminations. Show it in 'Clarifoil' and sell it!

Pack by W. & F. Walker Ltd.

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'Cellastine' acetate sheeting has strength, colour and versatility plus top-flight performance under vacuum forming and other methods of fabrication. Leading concerns choose 'Cellastine' for better results.

Vacuum formed game by J. & L. Randall Ltd.

Also in the range of 'Celanese' plastics are . . .

Spectacles by J. H. Newbury Ltd.

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TRADE MARK

Colourful 'Celastoid' acetate sheet is keyed to the latest trends in frame styles. For industrial personnel protection too, safety equipment manufacturers specify shatterproof transparent 'Celastoid'.

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Monoflex extruded flexible sections · **Wireweld** reinforced sheet · **Cinemoid** non-flam sheeting

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A new metal complex organic pigment for all types of plastics and rubbers. Irgalite Green Yellow 6GS can be used to produce a range of contemporary yellows and greens characterised by extreme fastness to light and heat. *Non-bleeding, non-chalking* and *rub fast.*

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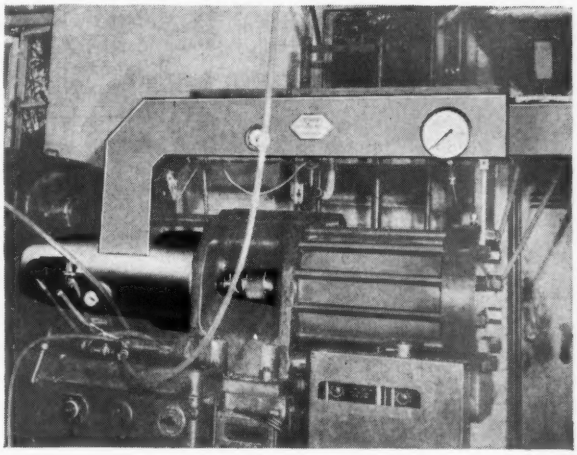
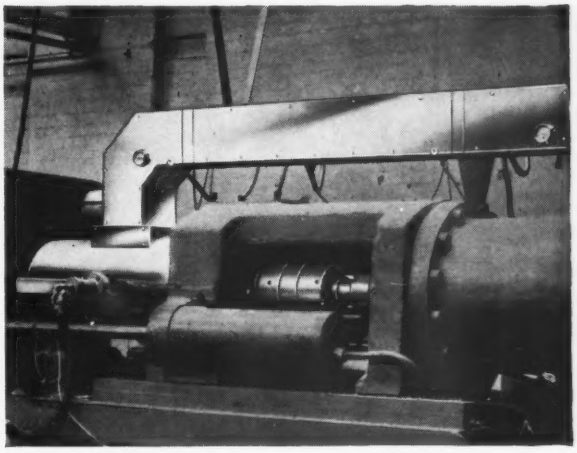
P42

Convert your existing machines to handle

BIGGER SHOTS
FASTER CYCLES
MORE POUNDS PER HOUR



AN 8-OZ. UNIT



A 16-OZ. UNIT. PHOTOGRAPHS BY COURTESY OF HALEX

DYKEHOUSE SUPER THERM 'CONVERSION' PRE-PLASTICISING UNITS

(COVERED BY U.S.A. PATENT NO. 2790203. WORLD RIGHTS PENDING)

* **READILY ADAPTABLE TO ALL INJECTION-MOULDING AND COMPRESSION PRESSES**
* **2-OUNCE TO 300-OUNCE SIZES**
* **PLASTICISING CAPACITIES UP TO 800 LBS. PER HOUR**

PRODUCTION ADVANTAGES At least 35% cycle increase on every mould. Ounces per shot increased by up to 300%. Casting area increased by 75%. Plasticising capacity increased by at least 100%. Accurate metering saves 4%—9% of material. Extremely rapid colour changes. Quality of moulding clearly improved.

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Telephone: WHitehall 0337 **Engineering & Service Division: Croydon**

it's extrudinary!

' Extrusion ' grade of East Anglia Plastics is made in both standard and High Acetyl Qualities and is especially compounded for this application.
' Extrusion ' grades are available in any required flow and in special formulations, too—it just depends on the individual end product. Typical applications for ' Extrusion ' grade are: thin walled tubular containers, drinking straws, sheeting, and rods for tool handles.
' Eanplast ' Cellulose Acetate Extrusion Powders are produced in a wide variety of attractive shades: opaque, pastel, translucent and transparent colours.
East Anglia Plastics Limited can always match any colour to customers' needs, as the colour possibilities of this material are almost unlimited.

East Anglia Plastics Limited

for Cellulose Acetate Moulding Powders

Also manufacturers and suppliers of: POLYSTYRENE · POLYTHENE · POLYVINYL CHLORIDE · SILON POLYAMIDE
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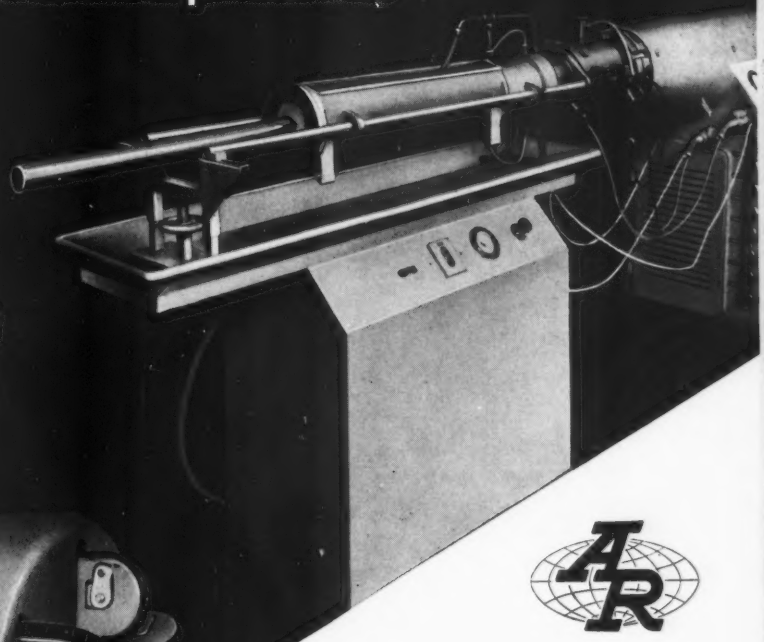
Factory at Temple Works, Strood, Rochester, Kent, England. *Telephone: Strood* 78441/2/3. *Telegrams: Eanplast, Strood, Rochester.*

EAP

TWO advances in processing thermoplastics

BOPP



Calibrating device

patents applied for

Pipe and cable haul off

patents applied for

Both of these new technical developments ease the manufacture of thermoplastic pipes by extrusion.

1. The calibrating device guarantees pipe true to size and shape when forming the extruded raw material. With this device the still soft section of the pipe is sucked to the inside wall of the calibrating device and cooled. In this way the thermoplastic material whilst passing through the calibrating chamber hardens into exact size and round shape required.

2. The pipe and cable haul off grips the pipe securely by six or three rubber covered caterpillar tracks set at an angle of 60° or 120° and pulls in keeping with the extrusion speed. The long working face of the caterpillars in firm contact with the pipe gives a high traction without slip and prevents deformation.

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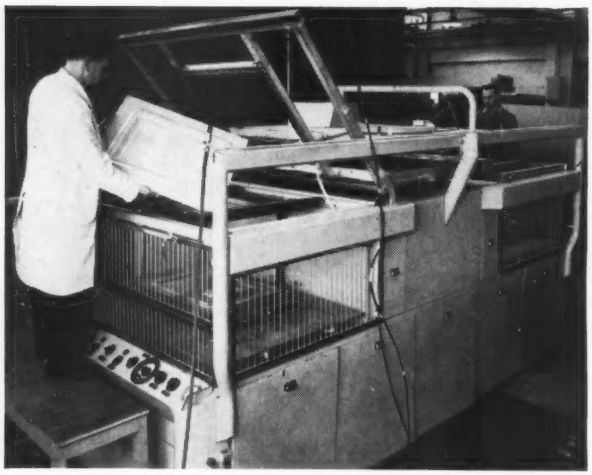
Photograph of double ended vacuum forming machine.



By courtesy of EKCO Plastics Ltd.

Erinoid

CP.20X for sheet extrusion

By courtesy of EKCO Plastics Ltd.

Vacuum formed door liner for Frigidaire *(Registered Trade Mark)*

Low sensitivity to changes in extrusion temperature conditions. Flow across the sheeting die is even and constant, giving very close thickness tolerance in the extruded sheet.

Yields a high-quality natural matt finish in the unpolished or unlaminated condition. The texture is exceptionally fine and close.

The heat stability of the natural base and of refrigerator whites is superior; resulting in much less waste due to degradation. This enables rework to be used more readily and, in general, colour change on re-extrusion is very considerably reduced.

Rework from high gloss laminate stock tends to blend more homogeneously with virgin powder during extrusion — this effects a more economic recovery of trimmings and off-cuts.

CP.20X Toughened Polystyrene—

the sheet material

CP.20X sheet for vacuum forming

Shorter heating cycles
Improved formability
Easy to stamp, cut and saw without fracture
Off-cuts can readily be injection moulded

'PLASTICS' photo.

Illustration of typical high impact polystyrene sheet extrusion unit.

FOUR good reasons why you should specify ERINOID CP.20X for your products

Greater all-over strength
Better impact strength at low temperature
Gives product a *permanent* matt or high gloss finish
Good colour stability

Erinoid CP.20X grade is manufactured by

STYRENE PRODUCTS LIMITED

Full information, samples, prices, etc. on application to

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For underlying excellence in good designs

Calofil

P.C.C. FILLERS

Calofil is a grade of Precipitated Calcium Carbonate which has been specially produced as an inert filler for glass fibre reinforced resin construction. It has these advantages.

- Surface coated—to increase compatibility with resin.
- Fine particle size—no settlement at normal loadings.
- White and chemically pure—no discolourations.
- Non-abrasive—no wear on cutting tools.
- Chemically manufactured—no batch to batch variations.
- Low oil-absorption—reduces costs.

This plastics lifeboat is 26 ft. long by 8 ft. 6 in. beam and is powered by a diesel engine. The vessel was built by Watercraft Ltd., from polyester resin-bonded glass fibre using Calofil as the filler. It will carry up to 50 persons and weighs only 32 cwt. complete with motor.

You will want to know more about CALOFIL
Write today for our Technical Bulletin No. 2

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Manufacturers of fine chemicals since 1823

"Well, it certainly sounds all right"

Exactly, and that is our problem. Because, described in words, any temperature controller can look *good, can* appear *to be exactly what you need, can* seem *to offer that degree of control vital to accurate and consistent extrusion or moulding. And certainly they can be* said *to be very reliable.*

BUT CAN WE PROVE IT?

Now we sincerely believe that the combination of qualities offered by our instruments — accuracy of control within fine tolerances, simplicity of fitting and removing the control unit, compact, sturdy construction — add up to a more efficient, more reliable, and more economical instrument. But having *said* all that we are left with the problem of *demonstrating* that a West Instrument really is the best one for use on your specific moulders or extruders.

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JP PROPORTIONING TYPE CONTROLLER, shown here, works within very fine tolerances, corrects for thermal inertia, does not overshoot control points. All components under-run for reliability. No thermionic valves; extremely robust. No transistors; unaffected by ambient temperatures. Control unit simply unplugs for service or replacement.

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B

THIS SIDE IS PLASTIC
THIS SIDE IS STEEL

THE COMBINED RESULT IS

PLASTIC BONDED TO STEEL

an exciting new material which will revolutionise 1,001 industries

John Summers & Sons Limited are now making what is undoubtedly one of the most remarkable materials ever produced by the steel industry—STELVETITE—a sheet of steel *permanently* covered on one side with a sheet of specially formulated Velbex P.V.C. made by BX Plastics Limited. The plastic is a thick coating, not a film, available in an enormous variety of finishes and colours, and its qualities include durability, resistance to acids, grease, water, hard wear, kicks, scuffs and chipping. *But this is only the beginning.*

Stelvetite can be bent and shaped! *Its bending qualities are remarkable—even through 180 degrees. Stelvetite can also be sheared, perforated and cut.*

Stelvetite can be deep drawn! *It is suitable for deep drawing and even extra deep drawing for special applications, with the plastic surface inside or out, and it may be seamed or crimped without disturbing the plastic surface.*

Stelvetite can be joined! *There are many ways of joining Stelvetite—even a special welding process which does not affect the plastic.*

As you will see, even from this, the industrial possibilities inherent in Stelvetite are enormous. In fact, wherever steel goes, there can go Stelvetite—the steel with the built-in finish.

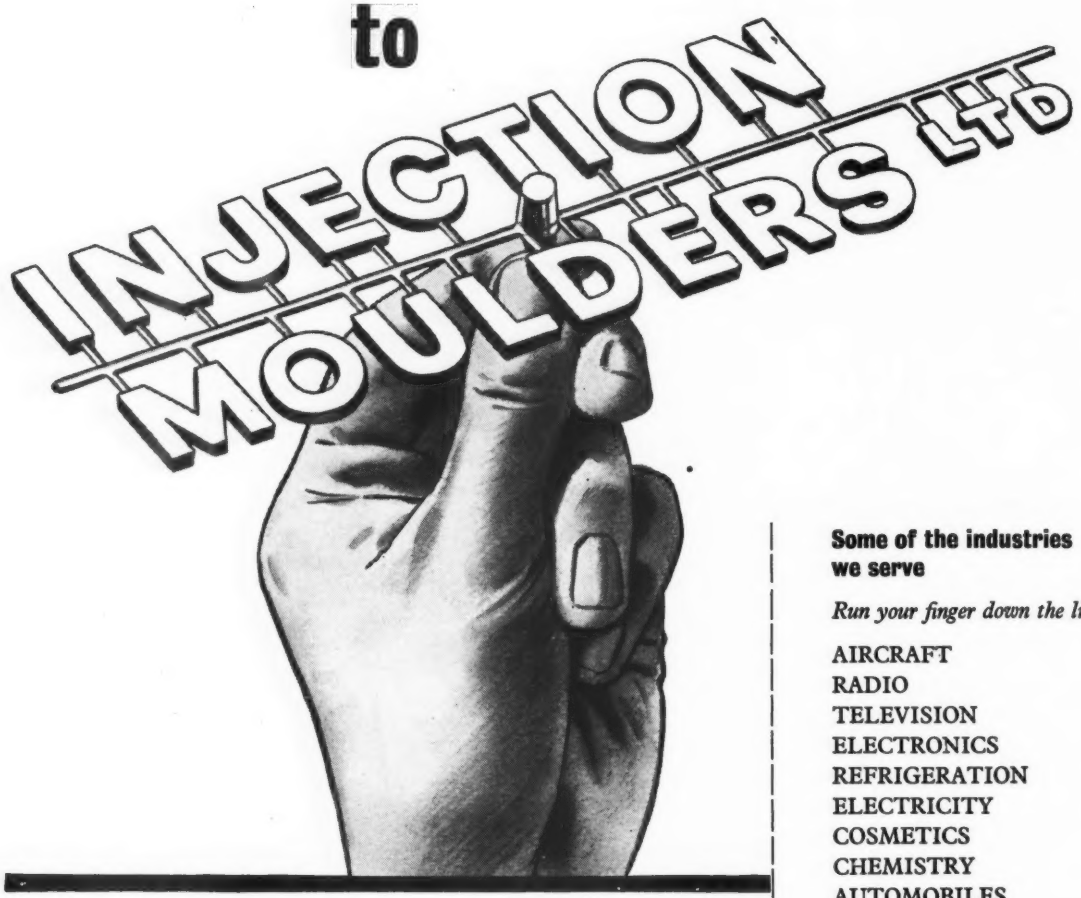
John Summers & Sons Limited and their products are known the world over. Stelvetite will be no exception. It is a revolutionary material produced by a free enterprise company whose policy is one of continuous venture. Write to: John Summers & Sons Limited, Dept. MRD.20, Shotton, Chester, for further details of Stelvetite.

MADE IN ENGLAND BY

John Summers & Sons Ltd

IN CO-OPERATION WITH BX PLASTICS LIMITED

Bring your moulding projects to



You'll be in very good company, for many big industrial "names" come to us for advice and help. We mould for practically every industry you've ever heard of (and some you haven't!) – in cellulose acetate, diakon, methyl-methacrylate, polystyrene, polythene, nylon, etc.

We'll be only too happy to discuss *your* particular injection moulding difficulties.

Some of the industries we serve

Run your finger down the list:

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RADIO
TELEVISION
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IM60R

Three frozen cheers for Electrolux

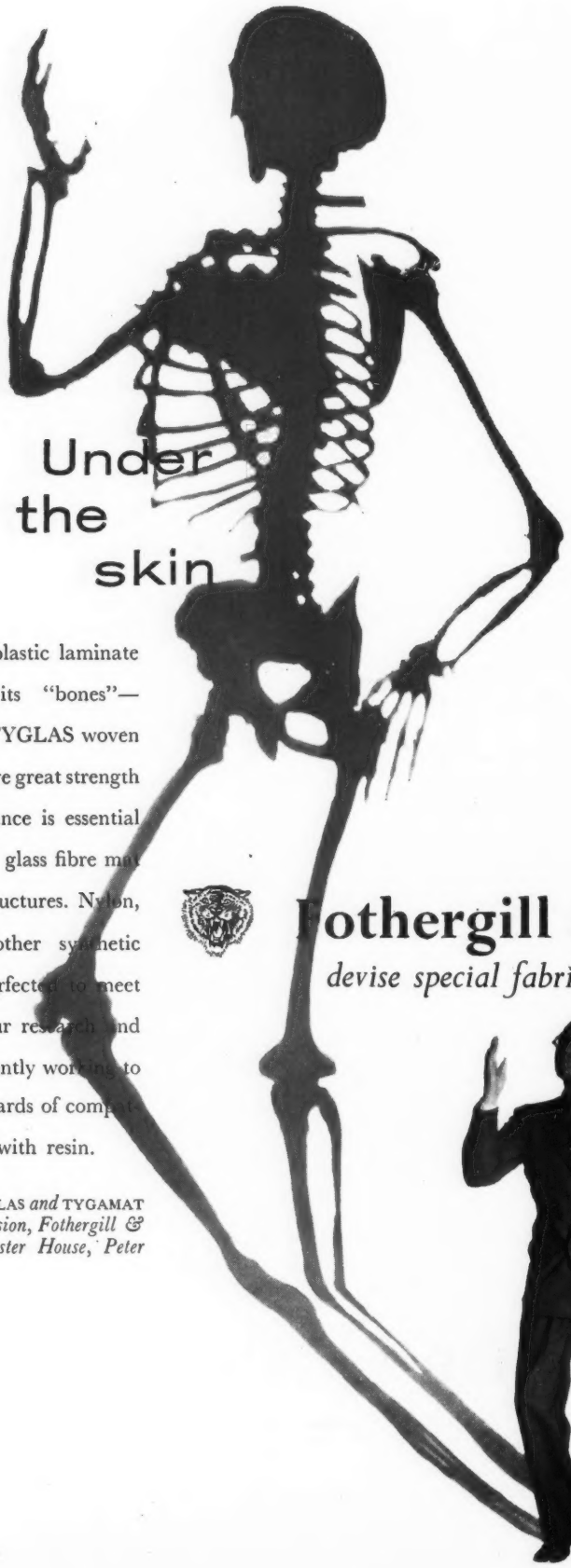
H'rm . . . H'rm! — said the MD clearing his throat: I have great pleasure in proposing a toast *(CHEERS)* to the Electrolux boys *(LOUD CHEERS)* on the production at Luton of their millionth fridge *(IMMENSE AND PROLONGED APPLAUSE)*.

Ladies and gentlemen, only a company of immense skill and enthusiasm in every department could make a million refrigerators for a people who are undoubtedly more cold more often and at more unlikely seasons than any nation in the world. Such a company is the Electrolux Company! *(MORE CHEERS mixed with cries of BRING ON THE TOAST)*. If proof of the far sightedness, the deep wisdom, the high technical intelligence of this Company be asked, I need only say that in every department of Electrolux only the best men, the best materials and THE BEST TOOLS ARE GOOD ENOUGH — AS IS PROVED *(he cried, raising his voice to a fortissimo)* BY THEIR INCREASING USE OF

DESOUTTER TOOLS!

(loud cries of "Oh . . . you self-advertising cad!" and "Push him in the fridge!")

DESOUTTER BROS. LIMITED, THE HYDE, HENDON, N.W.9. TEL: COLINDALE (5 LINES) GRAMS: DESPNUCO HYDE, LONDON.
CRC286



Under the skin

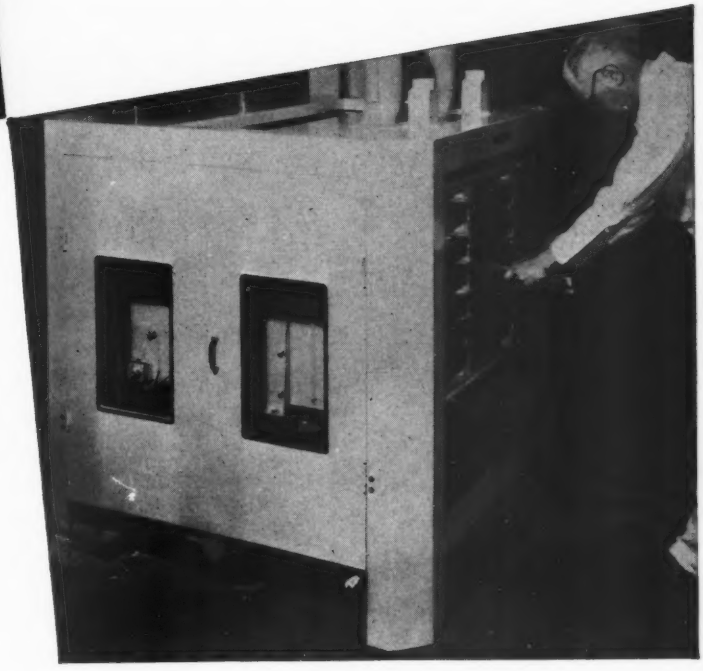
Fitness for purpose in a plastic laminate ultimately depends upon its "bones"—the reinforcing material. TYGLAS woven glass fabrics and rovings give great strength where high impact resistance is essential. TYGAMAT *HPA* bonded glass fibre mat is suited to other resin structures. Nylon, Terylene, Dynel, and other synthetic fabrics have also been perfected to meet the needs of industry. Our research and development unit is constantly working to achieve even higher standards of compatibility in bonding fabric with resin.

For technical literature on TYGLAS *and* TYGAMAT *write to:— Marketing Division, Fothergill & Harvey (Sales) Ltd., Harvester House, Peter Street, Manchester* 2.

Fothergill & Harvey

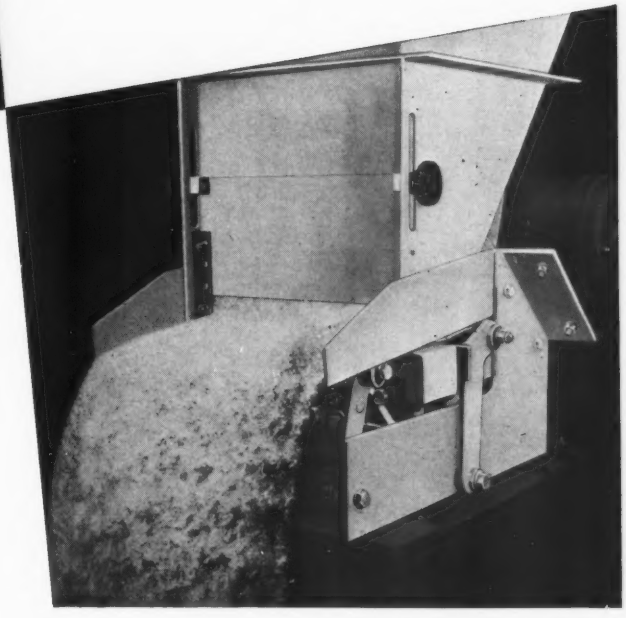
devise special fabrics for all industries

Sifting problems?



Not with the Simon Junior Sifter. The persuasive rotary motion of its horizontal sieves gives a gentle but positive separation of powders and granular materials. It is totally enclosed in a metal body and therefore dust-free.

Feeding problems?



Then use the Simon vibratory Velofeeder. It gives a controlled accuracy of feed on all solids from powders to 2″ lumps. Adjustments are made in seconds from high to low discharge rates within a 400-1 ratio.

Tests gladly made on your own samples. Why not consult us now?

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CHEADLE HEATH, STOCKPORT. Telephone Gatley 3621 (16 lines) Telex No. 66-287

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TRADE MARK

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The case is made from a Fibreglass preform, bonded with polyester resin, filler, and pigment to make the case self-coloured. It can never crack, warp or go shabby — a perfect case for the perfect portable — and yet another case of F.R.P. providing the backbone that is broadening the scope of plastics throughout industry.

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Resin supplied by: B.I.P. (Chemicals) Ltd.

Fibreglass have an F.R.P. advisory service, which is expert, confidential and free.

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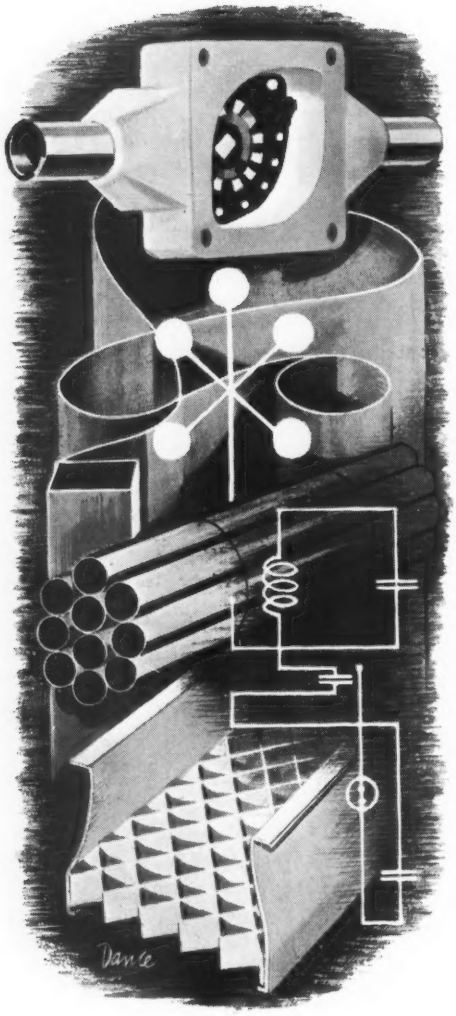
Elco Plastics Ltd.



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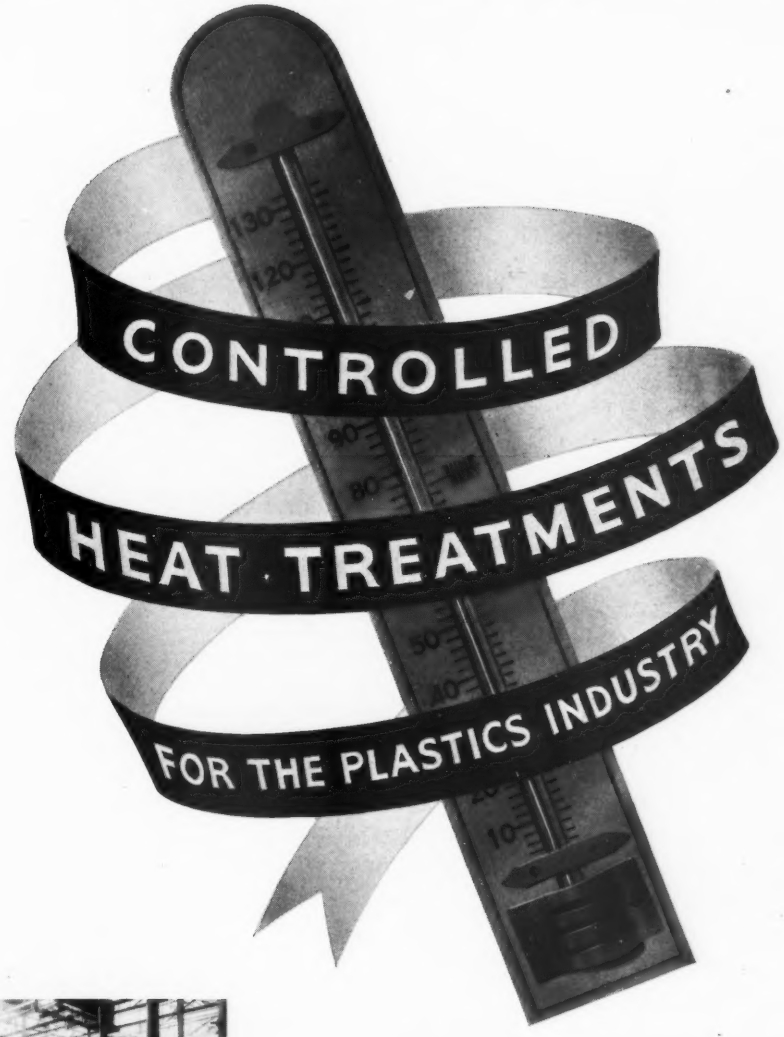

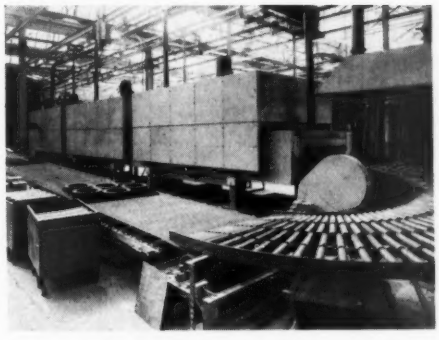

Curing range for Resin Bonded Asbestos products
Photo by courtesy of Ferodo Ltd.

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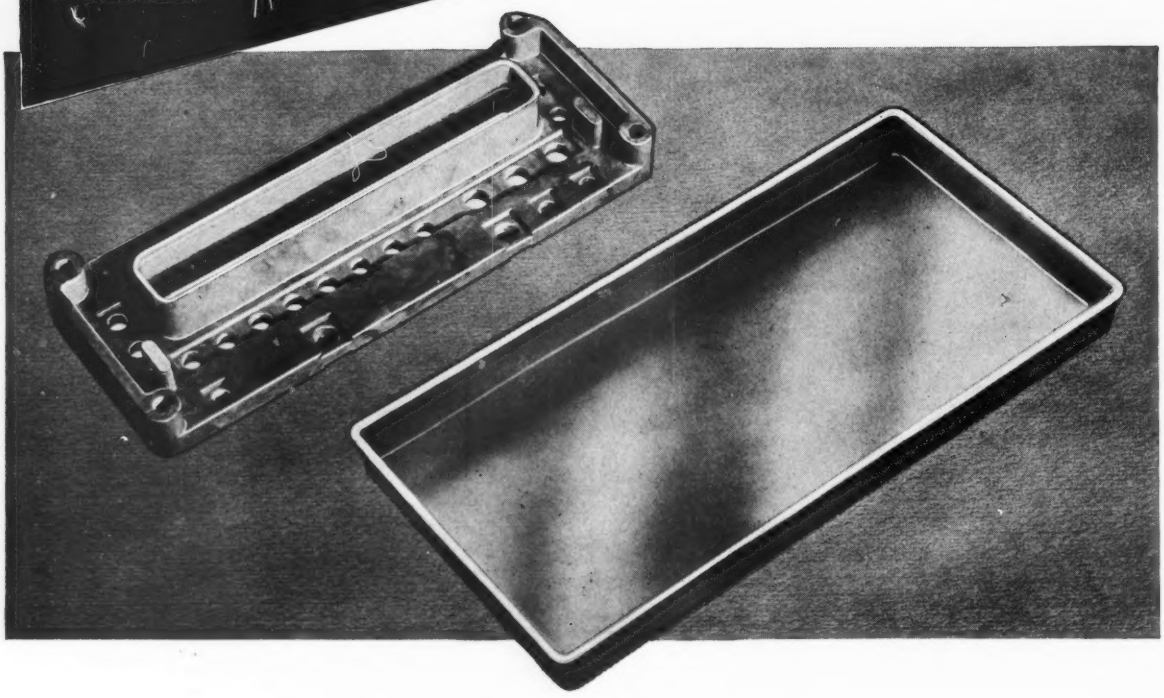

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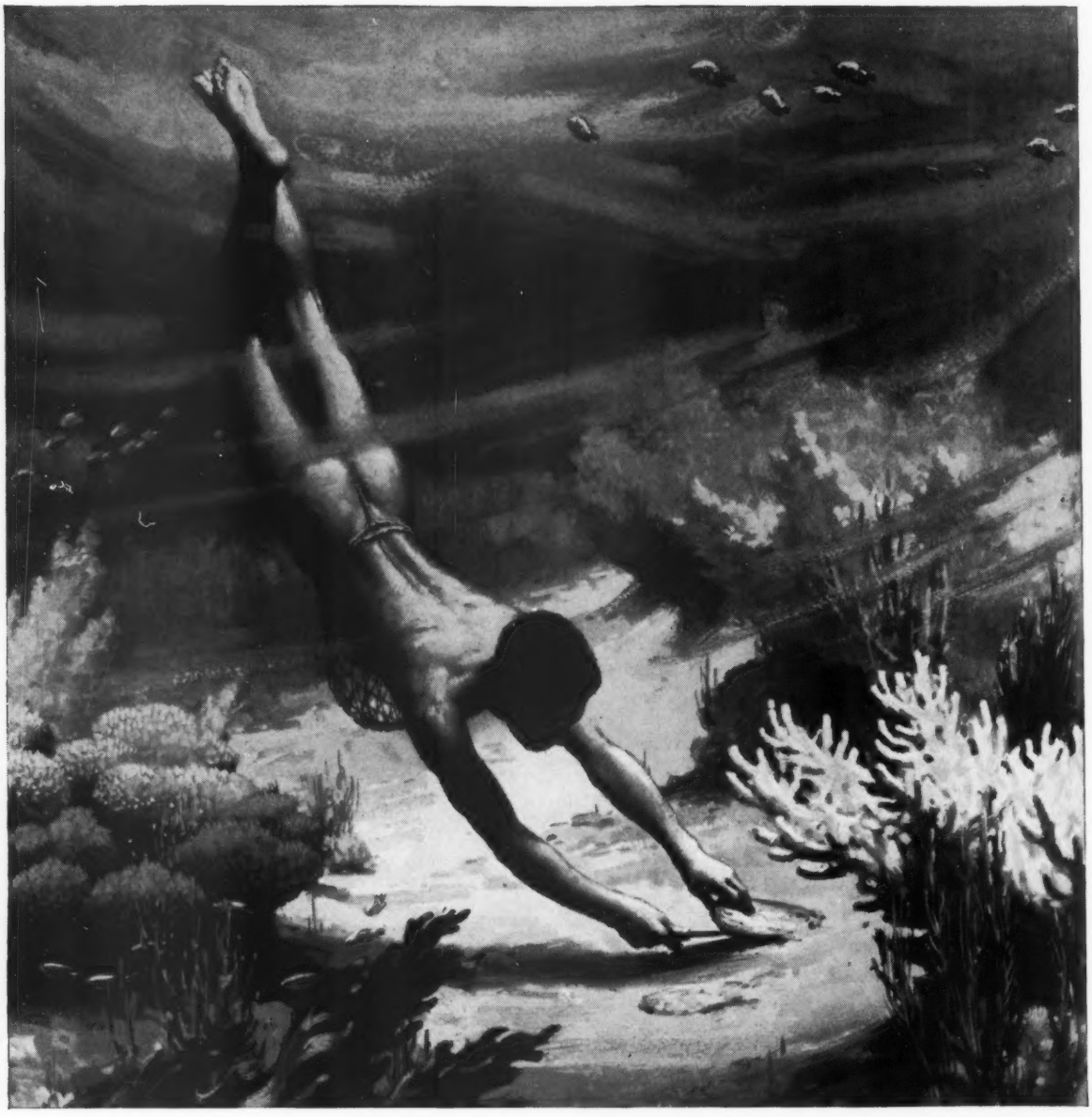

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The art of pearl-diving is one that has been practiced for many centuries, but very much more recent in origin is the practice of using synthetic agents to produce pearl effects in plastics.

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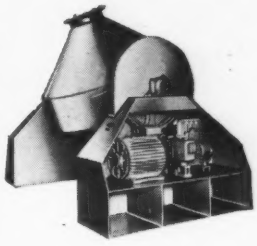

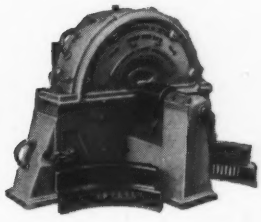

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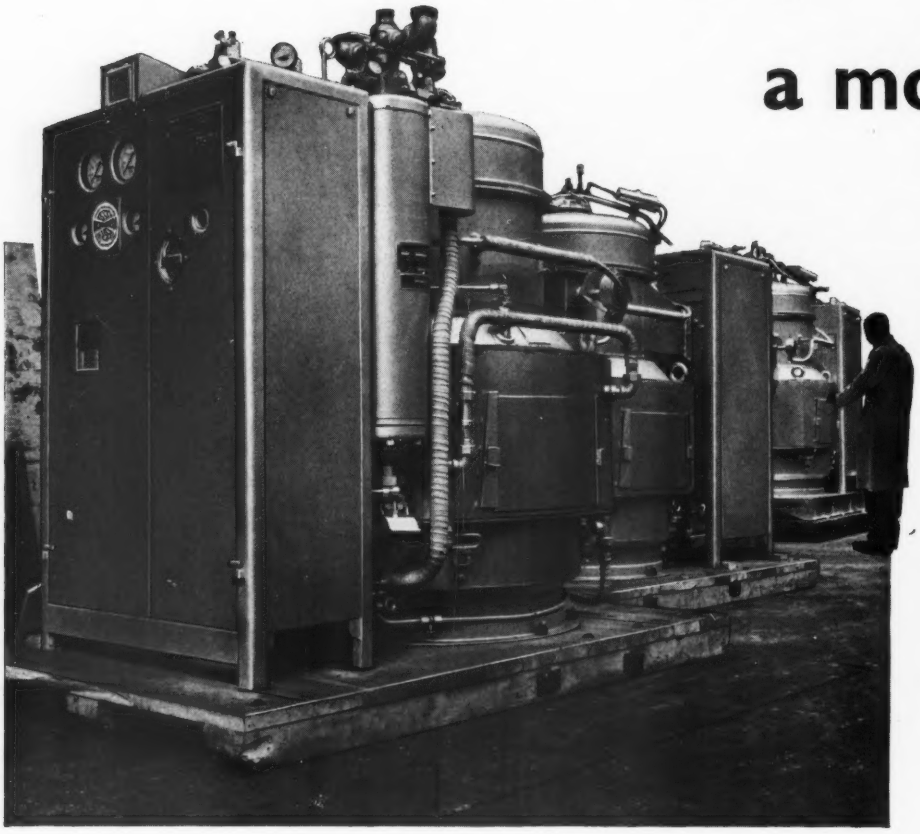
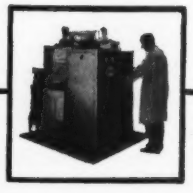
over fifty boilers a month!



Every month over 50 boilers of the Stone-Vapor design join the thousands already in service throughout the world—on railways, ships, and in every branch of industry. Why this great demand ? Because no other boiler can offer all the Stone-Vapor features. In single or multiple installations, the output of these oil-fired ' packaged ' boilers modulates with the demand, giving the steam you want only when it is wanted, automatically; used as boosters with existing plant, they will competently smooth out load peaks. Completely self-contained, Stone-Vapor steam generators can be installed anywhere, quickly and easily. Consider their advantages: gross weight to evaporation ratio less than 1.5 to 1; steam in two minutes from a cold start; installation without break in production; reduced piping costs and line losses; less fuel and water consumed; great saving in manpower—*and constantly high efficiency at all rates of evaporation.* No investigation of modern steam plant can be complete unless you have details and have witnessed the performance of Stone-Vapor steam generators.



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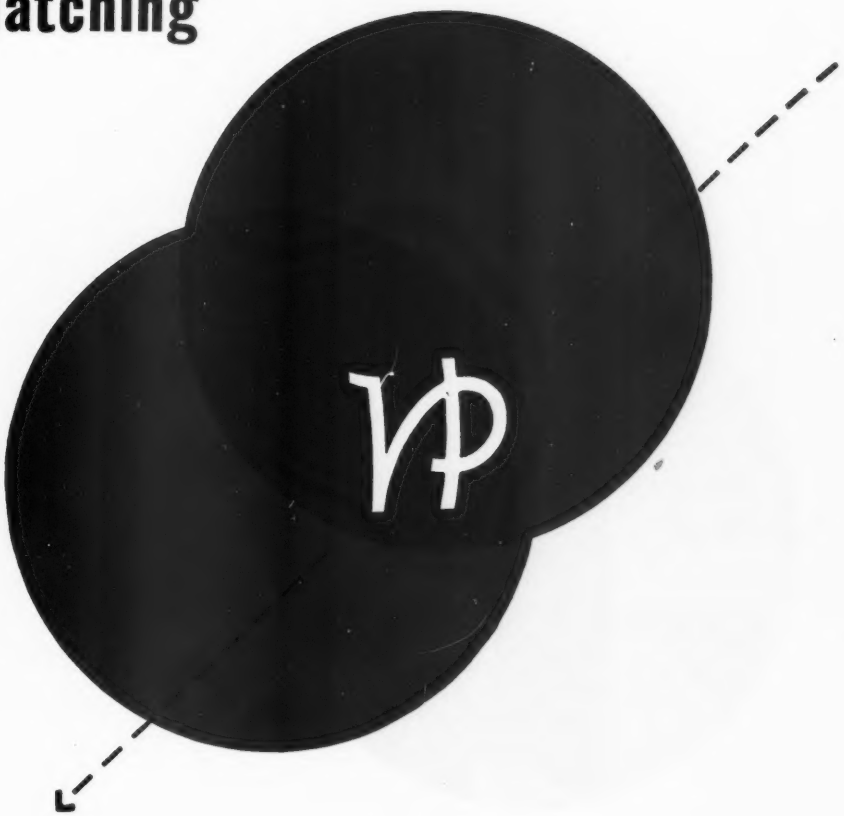

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Φ4

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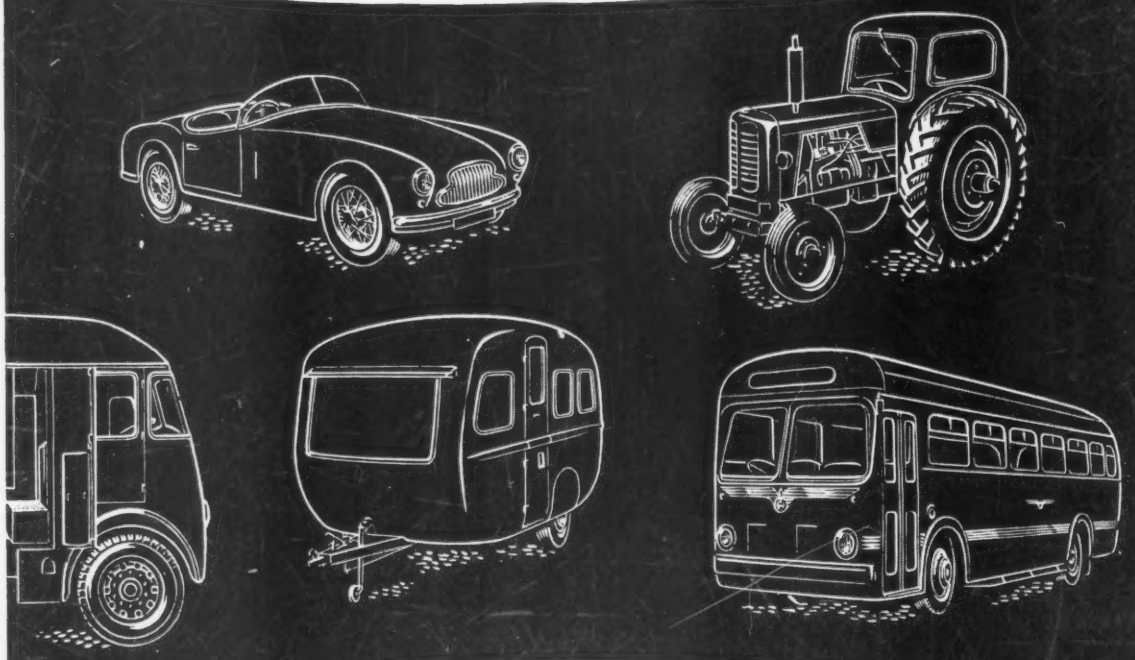

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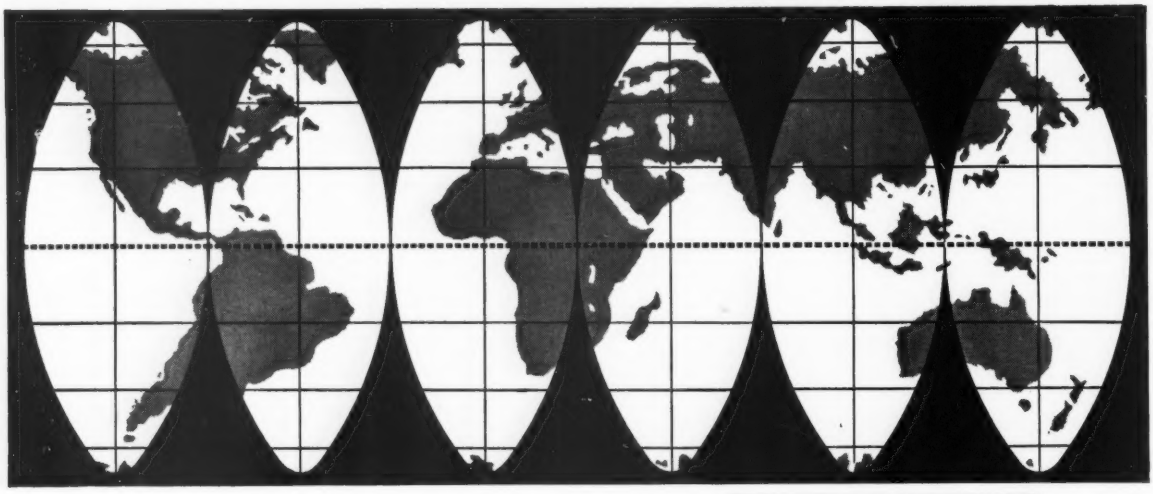

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Special purpose Acetate compounds are a feature of the Lustrac service. Lustrac develop Acetate with the characteristics tailor-made for each customer's requirement . . . for injection or extrusion; for extra toughness; flow controlled; to any colour. Here are just two functional examples of Lustrac Acetate at work . . . in production.

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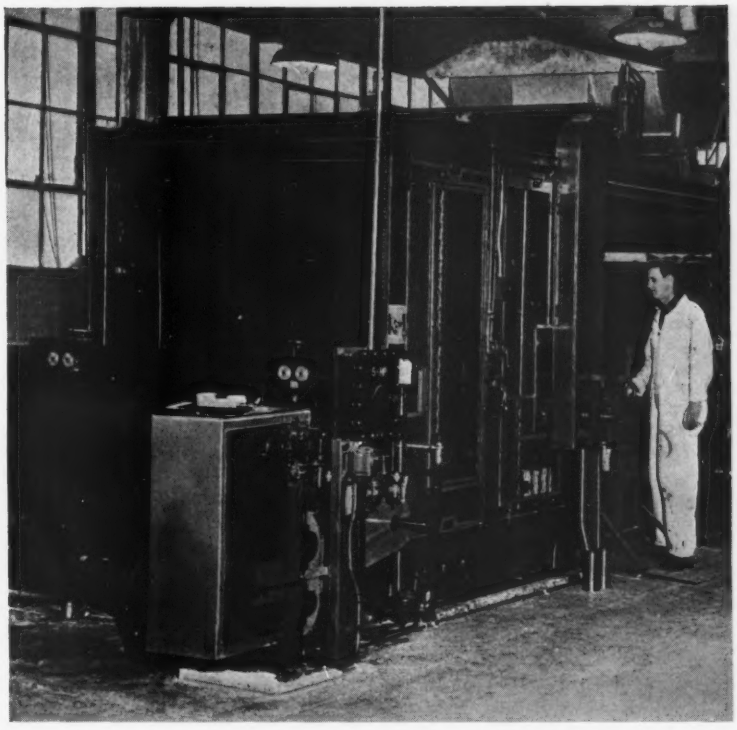
laminates embosses and prints

in one operation



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2 EMBOSSES

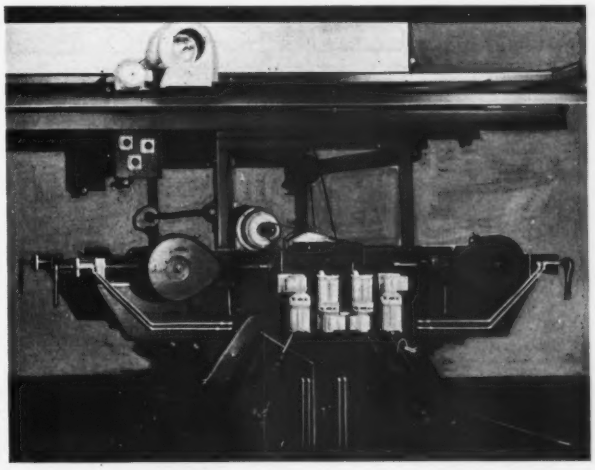
3 VALLEY PRINTS to closest tolerances

Compact, and costing only a fraction of mammoth equipment usually performing these jobs, it is especially practical for both short or long runs.

If your operation can benefit by fast, flexible equipment at considerably lower outlay and upkeep, you're invited to see the new LEMBO LAMINATOR-EMBOSSER in action. We will be happy to make experimental runs for you.

*Subject to proper film formulation and gauge.

LEMBO ROTOGRAVURE PRESSES



CUT DOWN SHUT DOWN! Hydraulic pressure on printing nips** permits operator to simultaneously back away all nips. Engraving rollers keep turning even while the printing machine is stopped. Ink doesn't dry on rollers. No wash-up needed. *Motorized Register Control* permits registry by operator from one position at panel board. Available, also, with electric eye.

Printers of all unsupported and supported plastic film prefer fast, quiet Lembo Rotogravure Presses for perfect, strain-free, in-register printing at speeds to 125 yards per minute. Shown right, 4-colour – 52″ between printing nips. Also, 6-colour – 60″ between nips.

**Optional equipment available at extra charge.

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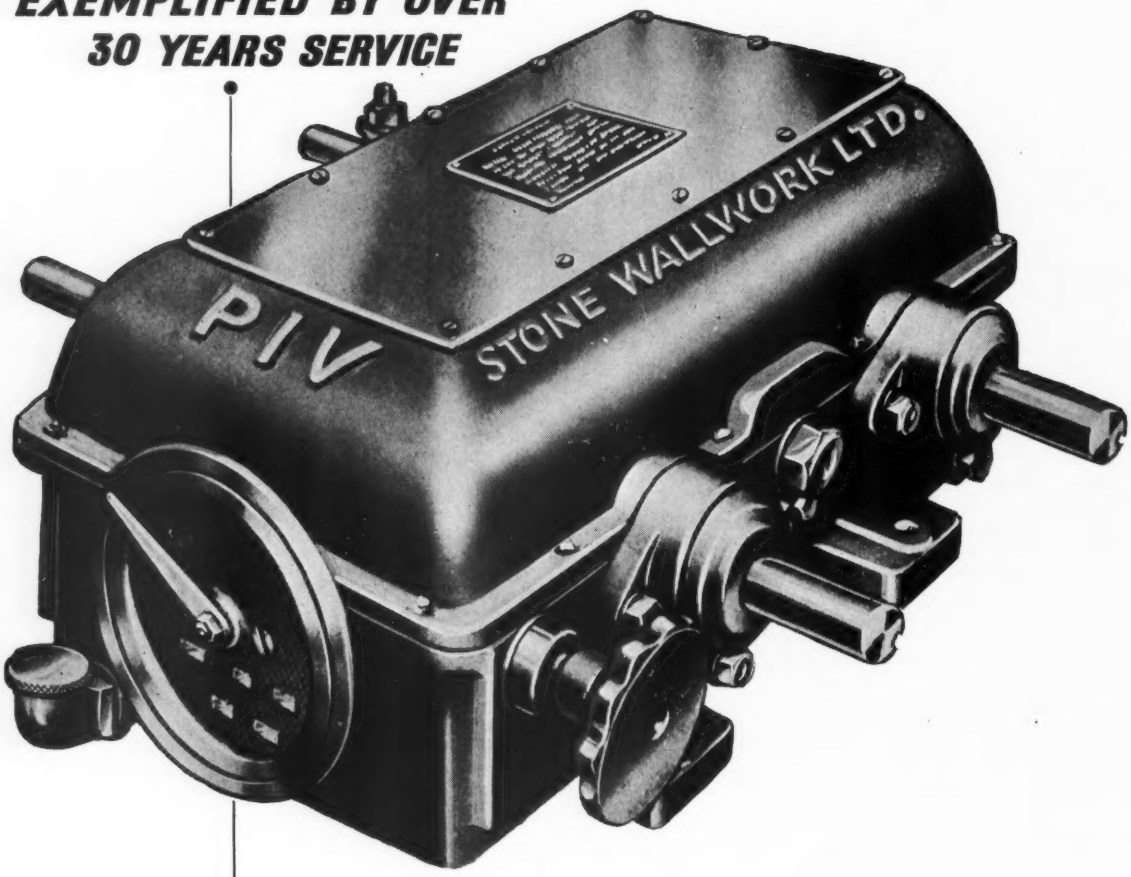

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The P.I.V. gear itself provides an infinite variation of speeds within a range of 6/1 giving, according to size, speeds of 1716/286 r.p.m. to 1225/204 r.p.m.

These speeds can be reduced to as low as 1·2/0·2 r.p.m. by using a Compound P.I.V. gear, whereby an auxiliary reduction unit of spur or worm gears is fitted integral to the P.I.V. gear.

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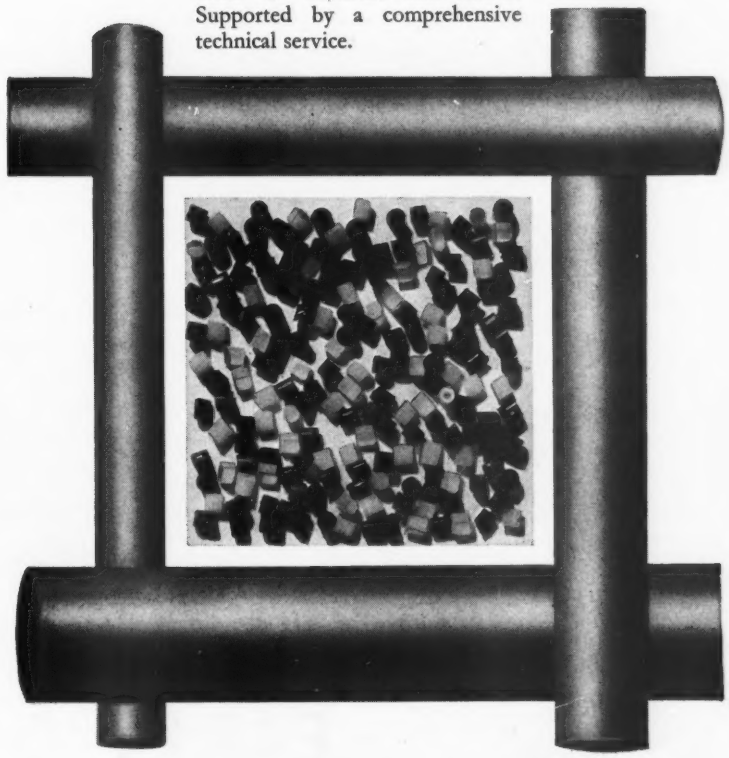

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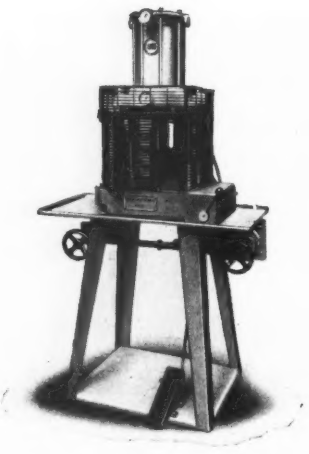

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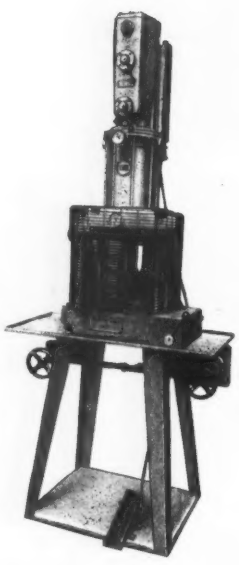
1, 2, 4 and 7 ton sizes.



Direct acting controlled pressure and speed. 1, 2, 4 and 7 ton sizes.

There are quite a number of operations in plastics for which E.M.B. Air Presses are ideally suitable :—

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- ★ Hot manipulation of plastics.
- ★ Impact hot forming of sheet plastic.

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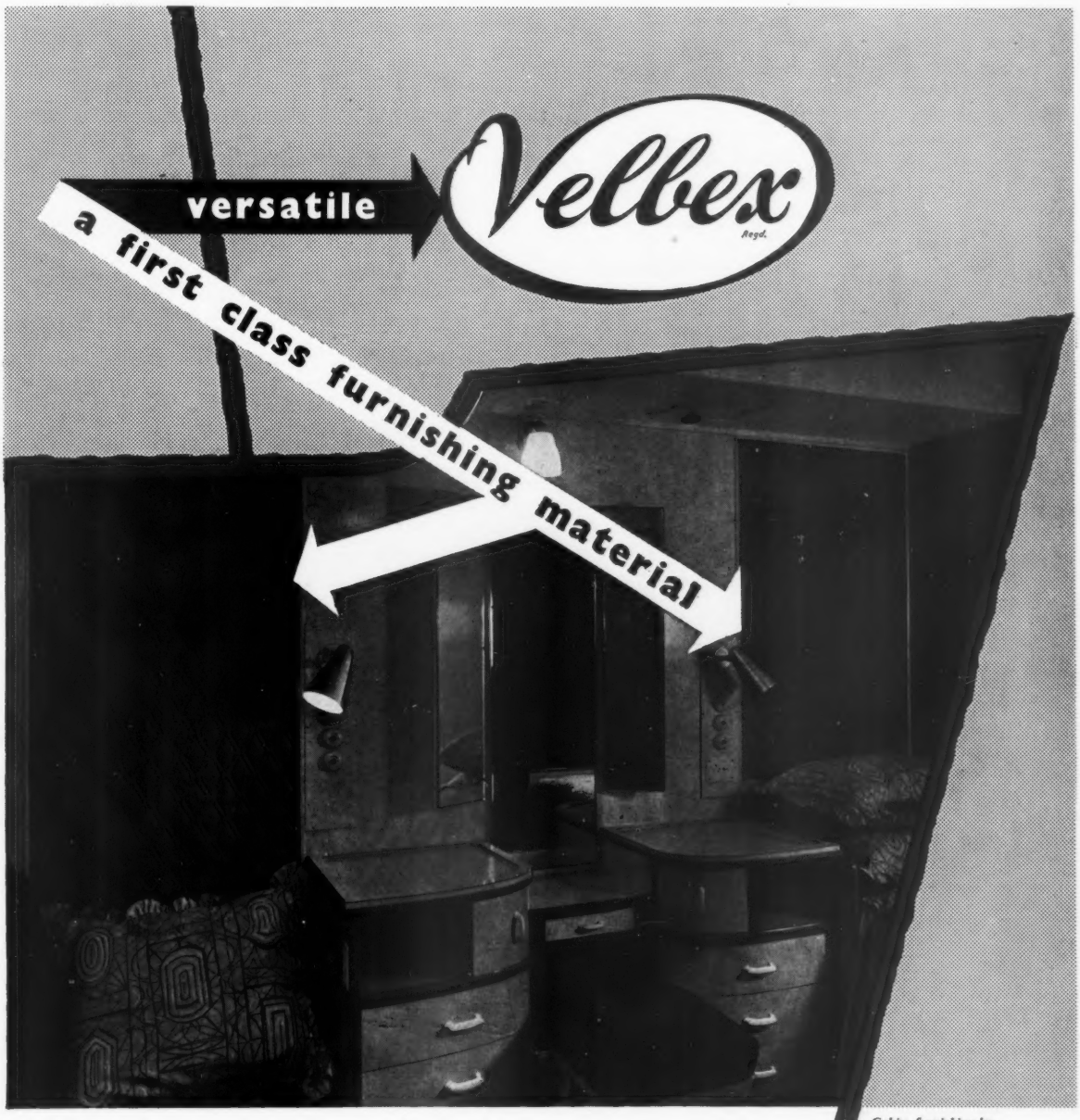

Cabin furnishing by Wylie & Lochhead Ltd, of Glasgow

This view of a first-class cabin in the Cunard liner "Sylvania" shows the upholstered bed-head panels which are covered with a new quilted form of Velbex. This new BX product, available in a range of attractive colourings, consists of embossed Velbex sheeting H.F. welded through a layer of wadding to a P.V.C. backing.

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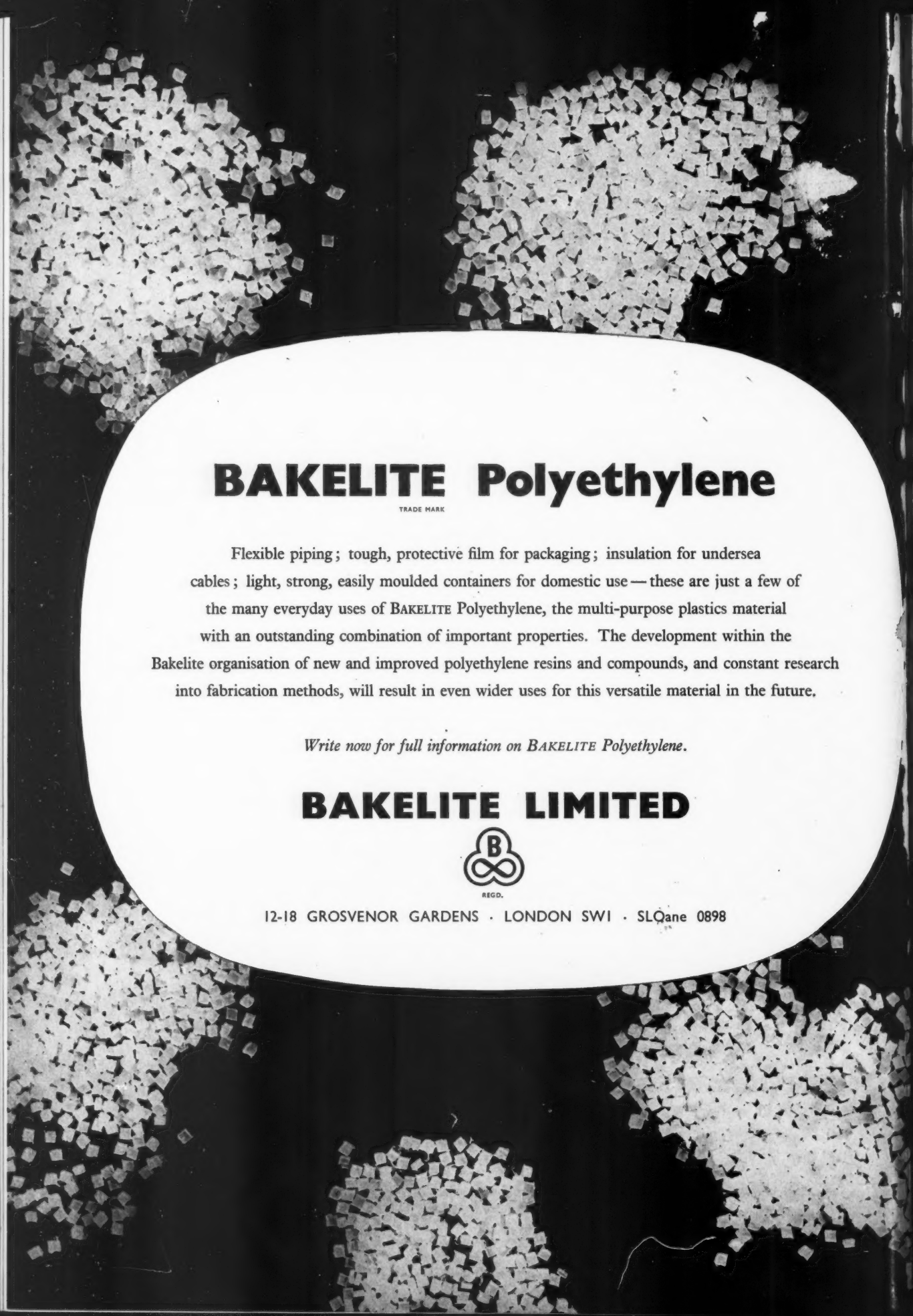
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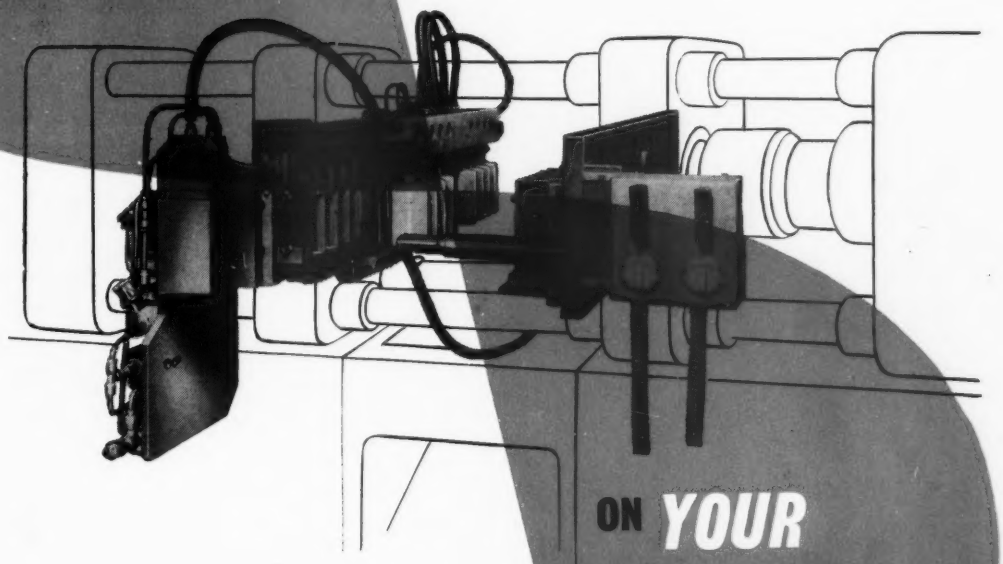

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It is now possible to purchase automatic special blow moulding plant! Simply adapt your standard injection moulding machine with the new, amazingly efficient Granbull Blow Moulding Unit . . . and open up fresh sources of profitable production. Designed for multi-impression work with 'push-button' speed and precision, to the maximum capacity of your machine. Write for full technical details.

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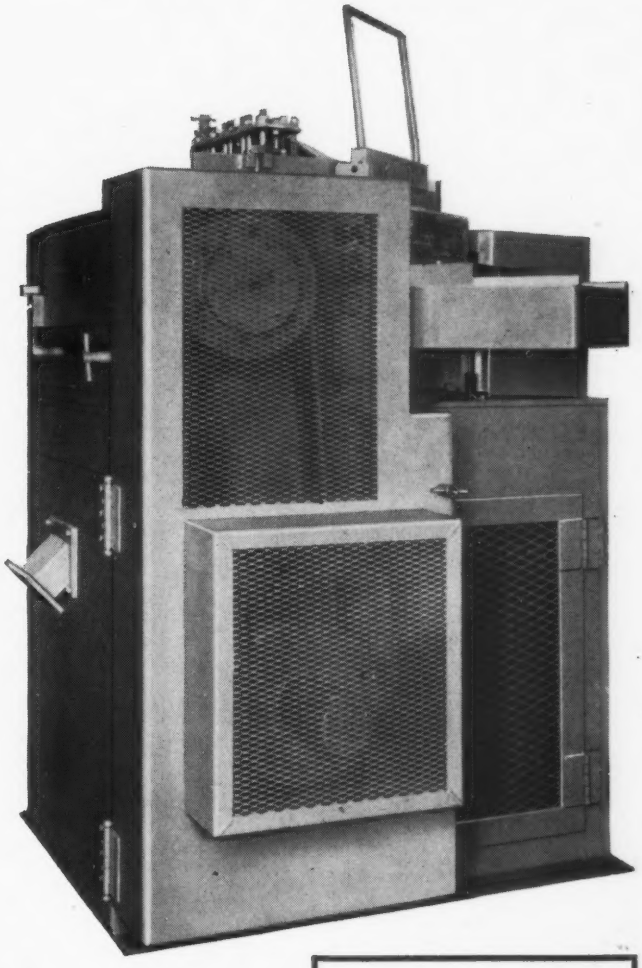
Cut from sheet stock in one shearing action

THE BURTONWOOD CUMBERLAND "STAIR-STEP" DICING MACHINE



Burtonwood-Cumberland "Stair-Step" Dicing Machine offers you a completely new method of dicing plastic materials. Perfect cubes, free from longs, are cut from sheet stock in one shearing action! All sides of the cube are cut cleanly. Cubes or rectangular pellets may be produced in various sizes ($\frac{1}{16}$ in. to $\frac{1}{2}$ in.) by simply changing knives.

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This Equipment is used by leading cable and plastic manufacturers throughout the world.

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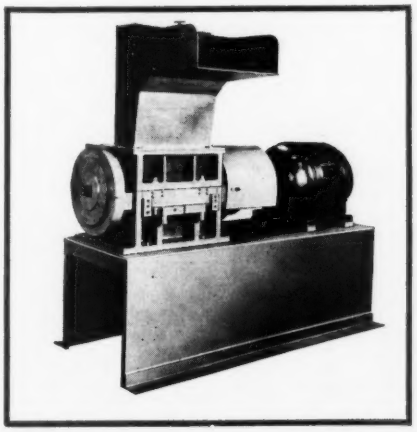
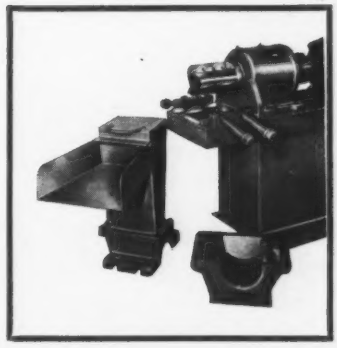
New additions to the existing range of equipment



MODEL 20

High capacity all steel granulator, ruggedly built, suitable for reclaiming extruder and injection mouldings. Machine waste in large pieces.



MODEL $\frac{1}{2}$

High capacity small machine, suitable for placing adjacent to individual injection mouldings machines, for sprues and rejects.

Manufactured under licence from Cumberland Engineering Company, Inc., United States

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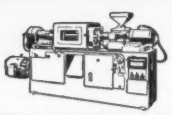
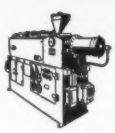
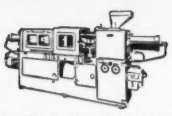


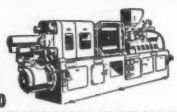
SH1
INJECTION MOULDING MACHINE



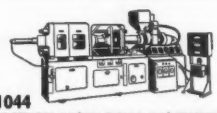
SH3
INJECTION MOULDING MACHINE



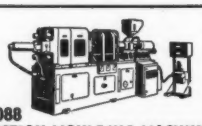
SH4
INJECTION MOULDING MACHINE



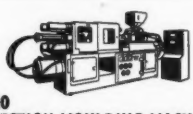
W30
INJECTION MOULDING MACHINE



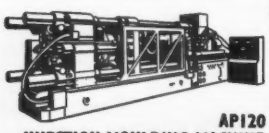
AP1044
INJECTION MOULDING MACHINE



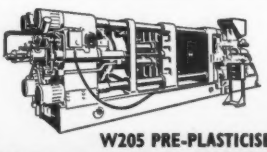
AP2088
INJECTION MOULDING MACHINE



W20
INJECTION MOULDING MACHINE



AP120
INJECTION MOULDING MACHINE



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EXTRUSION MACHINE

4½"
SINGLE-SCREW
EXTRUSION
MACHINE

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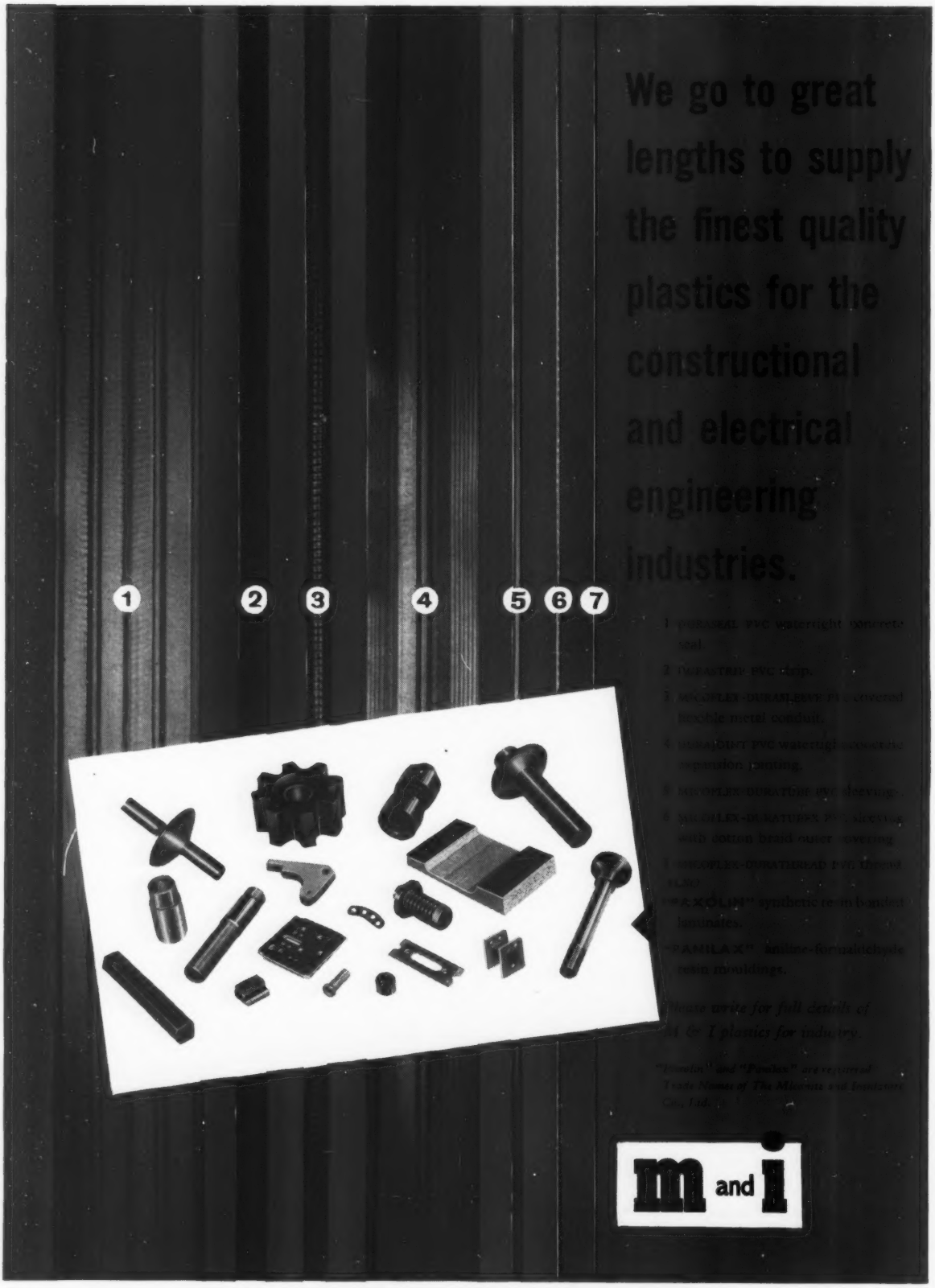

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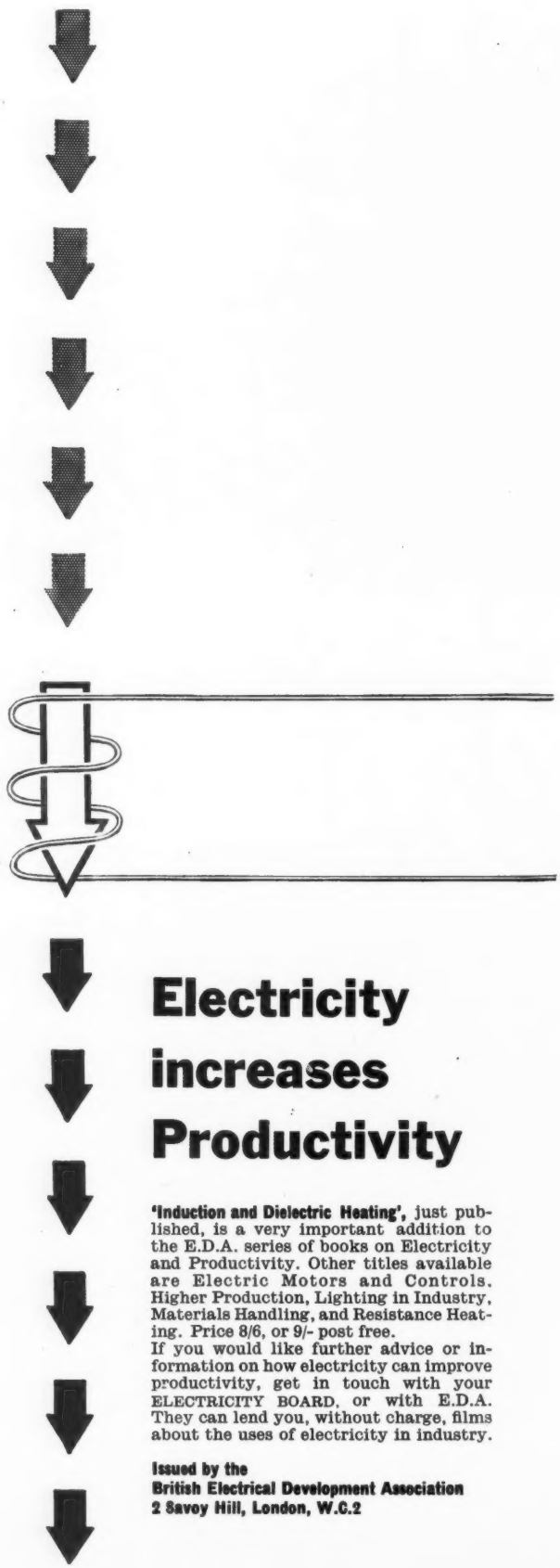

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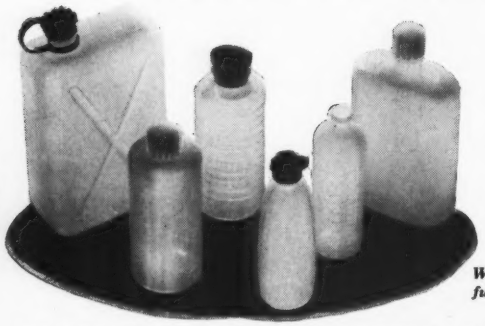

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Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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Nylon-reinforced coalmine belting in use in the Manvers Main Colliery. Made by British Belting and Asbestos Ltd., the nylon reinforcement is produced by British Nylon Spinners Ltd.

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Published on the second Wednesday of each month by the Proprietors, Temple Press Limited, and printed in England by Sir Joseph Causton & Sons, Ltd., London and Eastleigh
Annual Subscription Rate 44/–. (Canada and U.S.A. $6.50)

Editorial, Advertisement and Publishing Offices: Bowling Green Lane, London, E.C.1
Telephone: TERminus 3636

NP 60

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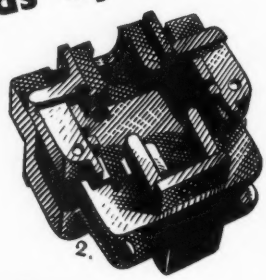
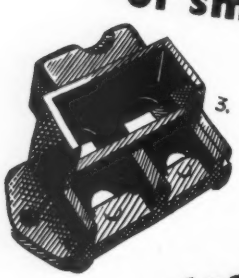
National Plastics make thousands upon thousands of small plastics mouldings for vital electrical and electronic equipment and can make thousands more





The design and manufacture of small mouldings, in large quantities, is just as much a speciality of National Plastics as the production of large and spectacular articles. Indeed, the making of a large multi-cavity mould to produce many small mouldings quickly is often a piece of fine engineering that only specialists can achieve.

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Plastics

VOL. XXII No. 242 NOVEMBER, 1957

EDITORIALS

Prophets on the Rampage

FROM time to time the industrial prophets vanish into their tents to throw a little incense or perhaps a few sacred bones on their holy fires, and after asking a few leading questions of their household gods, emerge to tell the assembled tribe what they have learned. Thus it is we have heard that some of the metals are petering out and that we are squeezing the earth dry of petroleum. And in our own field we hear that not only are the older plastics vanishing but that things are coming to such a pass that there is a limit to the number of new ones we can employ for they would be only slight modifications of those now in use and therefore economically unemployable. Well, we can only wait and see. So far as we know, none is yet quite dead and indeed all are, as was King Charles, an unconscionable time a-dying.

The thermosetting resins, and more specifically the phenolics, have been under fire in recent years because of the phenomenal advance of the thermoplastic moulding materials which have beaten them quite easily in the production race. But it should be remembered that by far the most important reason for the advance of the thermoplastic materials has been their capture of such a large slice of the vast domestic field which the phenolics could hope to enter but rarely. No doubt it seems feasible that a new thermoplastic may appear on the scene to replace the phenolics still further, but it must be remembered that these retain a strong hold where the need is high temperature resistance combined with rigidity, good electrical properties, mechanical strength and low cost. The time of disappearance is still far distant.

Moreover, progress is by no means at a standstill in the technology of their production. It was in our August 1955 issue that we reported on the work of a small company, Canusa Ltd. in applying the Buss Ko-Kneader at the final stage of producing phenolic moulding powders. Last month, E. Schneider and D. Brooks of that company delivered a paper before the Plastics Institute describing the progress to date. It is clear that the improved technique has resulted in better flow properties and consequently in higher rate of moulding and improved surface appearance of the finished mouldings.

Quite apart from this important kind of progress there are still *lacunæ* to be filled in the moulding shop itself to reduce costs. A recent issue of *Modern Plastics*, our American contemporary, describes the automatic compression presses used at one of Ford's works for producing distributor caps and water-pump impellers. This case, with the enormous requirements of such a company as Fords, is clearly very special, but the points made press home the advances that can still be made. The moulding powder is received in huge rubber drums each containing one ton of moulding powder and each of which, hoisted by crane over the feeding mechanism of the press, serves as the hopper. The powder is not made into preforms, but is fed, metered volumetrically, into p.t.f.e. cups which are automatically moved on to the preheater. The fully automatic presses themselves and the temperature control unit (circulating hot oil is used as the heating medium) are superbly designed and arranged. The whole is stated to be the first to use automation so completely, in feeding, in preheating the powder and in ejection of moulded parts. With such advances it does not seem that the end of the phenolics is even on the horizon.

Research Institute

IT is with considerable pleasure that we receive the news that the Society of Plastics Engineers of the U.S.A. has appointed Mr. Jerome Formo chairman of a special committee to develop plans for the formation of a Plastics Institute. The institute in question will prove a very different structure from our own, since primarily it will provide facilities for research both fundamental and development, education and an unparalleled library for reference and studies.

This is a magnificent and timely creation and in wishing it the success it so obviously deserves, we cannot withold an expression of envy that in spite of our own exhortations, no attempt to create such an organism of research, or what is perhaps more important in this country—a technical development centre for plastics, has ever passed the idea stage. It is a strange commentary on our own industrial set-up that the bulk of our companies do not believe in this type of life insurance. The members of the Society of Plastics Engineers of the United States obviously do. We prophesy that most of them—no, all of them—will reap the benefit in the years that lie ahead.

Ashdowns Ltd.

ALL readers will, we are sure have noted with regret the closing of the works and the ceasing of production of Ashdowns Ltd. one of the oldest of plastic moulding companies in the country. To us personally the regret is intense, since for more than 20 years the works have always been open for us to visit, to discuss problems and to carry away and use any technical information we had acquired. We had seen the fine system and plant from the early " compression only " days to the production of special laminates, the newer glass-fibre structures, new polystyrene extrusion and " Perspex " forming plant.

Fortunately much of the work will continue and we are delighted to inform our readers and the company's past customers that not only will the " Ashlam " trade mark continue, but it, together with all manufacturing rights, techniques of silicone, epoxy, phenolic, melamine and polyester-bonded glass structures and laminates are transferred to Messrs. Mica and Micanite Supplies Ltd., of Barnsbury Square, London, N.1, who have long worked in the same field. This company will also supply these laminates in their copper-clad form for the fast growing printed circuit industry. The change over has already been made and in fact there has thus been neither cessation of production nor of supply to users.

The Expanding World

THIS is not a dissertation on the physics of the Universe but on more down to earth facts such as: a cubic foot of lead need no longer weigh 706 lb. Also, as we all know now, any synthetic resin or polymer which normally weighs from 60 to 80 lb. a cu. ft. can be made to weigh almost as little as you like, say 2½ lb.

per cu. ft. The " foamed," or rather the expanded plastics have really arrived and a new big little industry has begun in earnest.

This is not to say that they were entirely unknown before. Indeed we reported in this journal more than 20 years ago (*Plastics*, June 1937, p.15) the production of a full-sized door made with 2-in. thick expanded rubber " Onazote " faced with wood veneers, which we could lift with one hand. Perhaps it was a little before its time so far as such applications are concerned for it is only within the last two years that the newer expanded plastics have loomed large in the public eye. An example is the development of expanded polystyrene, discussed elsewhere in this issue in an article by Mr. A. Cooper.

It now also appears to be the turn of expanded rigid p.v.c. to take the stage, to be described in a forthcoming issue, for if its rigidity and comparative strength is considered combined with some of its other characteristics e.g. chemical resistance and its non-interconnecting cell structure, it is clearly one of the more interesting of new materials of construction.

Immediately comes to mind, because of the present wide interest in glass-fibre laminates, the inevitable incorporation of expanded rigid p.v.c. for the production of unsinkable boats, and indeed several, including a 16-ft. Admiralty type launch have already been produced. We have only to realise that here we can make ½ in. or 1 in. planks of this p.v.c. and using normal boat construction, build a frame-work that is truly unsinkable. Even were a hole made in the side of such a structure below water level, it would not sink since its specific gravity can be between 0.04 and 0.2. In the cases of those boats already produced such frames have been covered with glass fabric/resin skins to increase strength.

Obviously this new " sandwich " structure has its outlet also in the chemical and other industrial fields.

MOULDING POWDER AND SHOT

We Found a Valley

Went to see the film of Colette's *Mitsou* which I had first read so surreptitiously behind the hay-stack 100 years ago because it told the story of a chorus girl's life during the first World War (or was it the Crimea?). Too corny and my sympathy was with old man Gravey who gets nothing for his money and is one of the best of French actors. Nothing but this film had been publicized so I left my seat to go home when a second started—called *We Found a Valley* and which from the opening words was a " documentary." I was brought up with a jerk, for it began the story of a British Petroleum Company's survey in the strange, empty and awful desert land near the Persian Gulf and the erection of a petroleum refinery. I don't want to appear too excited about this, because it affected me personally—I had worked in a petroleum refinery in a difficult country myself, and you may wonder how any emotions can be aroused by seeing such a job put up. But I hope you will all try and see it, because of this overseas industry's importance and of others like it to this country and to our own industry—because of the technicalities divulged, the stupendous engineering feats that are carried out and even what such vast capital expenditure it means. You may also get an inkling of what the opening up of such territories means to poor communities. There is a splendour about this film that knocks the trivial film into a cocked hat. I came away thinking what it means when, as has happened elsewhere, blind nationalism can grab all and destroy the work of years. It's a must for everybody with any understanding of world affairs including all our members of Parliament. The film unit of B.P. tells me, the film can be obtained free for showing at technical institutes together with a man to turn the handle.

* * *

More about "Foams"

We are not the only industry that sometimes thinks in terms of expanded materials; workers in metallurgy have been concerned with producing " foams " for some time. One of the more concrete results has been announced in the U.S.A.—foamed aluminium, which is stated to be possibly competitive with timber (one type is only slightly heavier than balsa wood weighing only 15 lb. per cu. ft.), since it can be sawn and otherwise worked. However, it is stated to lack high compressive strength which makes me wonder if the foam could be made with interconnecting pores and at least partially filled with a plastic material, say p.v.c. plastisol and subsequently hardened. Production of a foam of aluminium must be a very different pair of shoes from that of plastics because of the high temperature necessary; presumably something like metallic hydrides may be employed to give off hydrogen at over 600° C. A plastic-filled metal " foam " could be produced even more readily using that very curious 50/50 aluminium-magnesium alloy which can readily be expanded without any agent. The " cells " are in fact fine vertical tubes running from the base to the surface.

Hard Technical Note

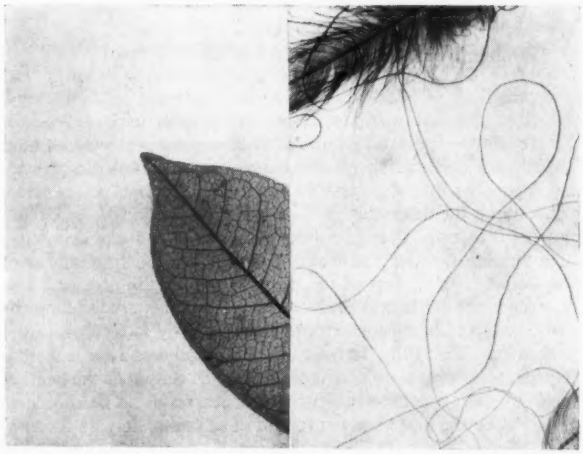
One of the most interesting of developments in machine production is the addition to the extruder of escape vents or channels through which volatile components in the resin may be removed by vacuum. This advance which was referred to at the Plastics Convention in July by a speaker from the Troester Company and presumably such machines are now available in Germany. I have already seen photographs and drawings of this type now being made in the U.S.A. by Welding Engineers Inc., Norristown, Penn. The obvious advantage is that moisture content can be removed thus eliminating the need for pre-drying plant and making the apparatus still further self-contained. I should say this opens up the feasibility of removal of other volatiles at low pressure and experimentation on preventing decomposition of rigid p.v.c. in the press by deliberate admixture of specific surface active " lubricants " which can be removed, at points near the die, by vacuum.

* * *

Flora Fauna Laminæ

Have received some samples of a decorated laminate (probably acetate sheet) which carries inter-leaved a curious assortment at will, of feathers, leaves, bits of string, cotton or other natural materials as the decorative medium. Below are two examples of it. I saw the laminates in Paris where they are made by Etablissement Fibre and Mica who possess the licence from Polyplastex United Inc. of the U.S.A. The materials can be used with considerable effect for making book covers, " windows," draught screens and decorative panels generally. I think this is very similar to the lamp-shade I once received from BX Plastics Ltd., in which the decorative material used was of fine grasses. Very pretty too.

DOGSBODDY.



Expanded Polystyrene

By A. COOPER,* F.R.I.C., F.I.R.I., F.P.I.

A review of the properties and methods of fabricating Polyzote, an expanded polystyrene recently launched by Expanded Plastics Ltd.

ALREADY as far back as 1938, Expanded Rubber Company Limited embarked on a programme of research on expanded plastics, and by the time the second world war was over, had expanded by some means or other all important plastics and elastomers available in Great Britain. These were tested and evaluated as to their commercial possibilities. Some were too costly to be of any interest; others could be expanded only with difficulty, but nevertheless the seed then sown by the Company, specializing solely in the field of expanded products, has been the means of reaping some reward. The encouragement was sufficient to register Expanded Plastics Limited, a wholly owned subsidiary company of Expanded Rubber Company in 1942.

One of the results of these activities was the birth of expanded polystyrene, patented in 1943 and designated " Polyzote." One of the first descriptions in the press of the work of the company was in *Plastics*, February, 1944, pages 55–56.

To commence with, the supply of monomer being very limited, only slow progress was made. Another difficulty was obtaining a really low density. At 3 or 4 lb./cu. ft. it was commercially unattractive, but as a result of a joint development between E.R.C. and B.X. Plastics Limited—a member of The British Xylonite Group of which E.R.C. is also a member—these earlier difficulties were overcome. B.X. Plastics Limited now manufacture the raw material.

Similar developments, though seven years later, took place in Germany.

Polyzote is marketed by Expanded Plastics Limited, in the form of expandable granules, and also in the form of mouldings ranging from small refrigerator parts, to large buoyancy blocks, and in the form of thermal insulation boards and pipe sections.

The granules resemble polystyrene injection moulding powder, but contain a blowing agent which is made active at elevated temperatures, most conveniently at approximately 100° C. (212° F.), when it is possible to obtain an expansion of more than 60 times their original volume. This surprisingly high degree of expansion is illustrated in Fig. 1. The weight of the material in

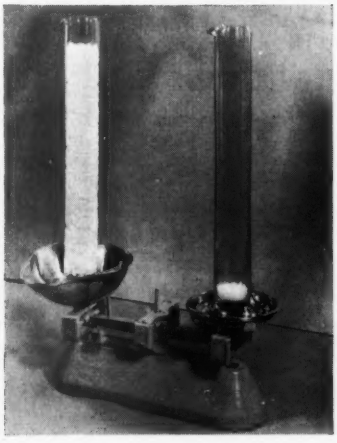


Fig. 1. Demonstrating the volume increase, following heat treatment, of Polyzote.

the counter-balanced measuring cylinders is identical, but after heating the granules for two minutes in boiling water, their volume is increased as shown.

On examining one of the expanded granules under a microscope, a closed cell structure can be seen, as in Fig. 2, which is the magnification of the cell structure of X50, using transmitted light. It has been calculated from this photomicrograph that approximately a quarter of a million cells are present in a cubic inch of the material at a density of 2 lb./ft.³. The properties of the finished product depend largely on this cell structure. Thus, for example, the thermal conductivity for a 1¼ lb./cu. ft. material is only 0.22 B.T.U./sq. ft. hr. °F./inch at a mean temperature of

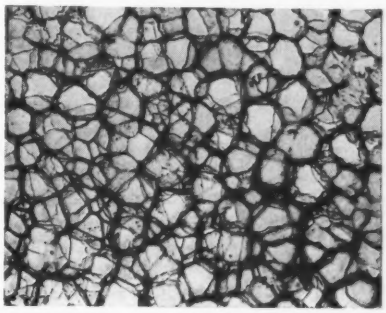


Fig. 2. A magnification of X50 shows clearly the closed cell structure of an expanded Polyzote granule.

50° F. The water absorption after six weeks total immersion is only 2%, and the water vapour transmission under tropical conditions, that is 38° C. (100° F.) and a 1–90% relative humidity gradient, is only 80 grains/sq. ft./24 hr./2 in. thickness. These

TABLE I. PROPERTIES OF POLYZOTE

Standard density (nominal)	1.25 lb/cu.ft	20 kilo/cu.m
Thermal conductivity	0.22 B.Th.U / sq. ft. hour. °F/inch at a mean temp. of 50° F.	0.0273 kilo. cal / m². hour. °C/m. at a mean temp. of 10° C.
Water absorption	2.0% by vol., after six weeks' total immersion	
Water vapour transmission at 100° F. (38° C.) and 1–90% relative humidity gradient	80 grains/sq.ft./24 hr./2 in.	55 gm/sq.m/24 hr./51 mm
Coefficient of linear expansion	0.000022 per °F.	0.00004 per °C.
Maximum recommended temperature	140° F.	60° C.
Specific heat	0.29 at 68° F.	0.29 at 20° C.
Compression strength (ultimate breakdown load)	15 lb./sq. in.	1.05 kilo/sq. cm.
Tensile strength	18 lb./sq. in.	1.25 kilo/sq. cm.
Impact strength	0.03 ft. lb. on ½ in. × ½ in. unnotched Izod at room temperature	0.040 joule on 12.7 mm × 12.7 mm unnotched Izod at room temperature
Modulus of elasticity in compression	400 lb./sq. in./in.	11.0 kilo/sq. cm./cm.
Resistance to chemicals	Resistant to all dilute acids and concentrated alkalis, but not to aromatic, aliphatic nor chlorinated hydrocarbons	
Odour	None	None
Standard thickness	2 in. 1½ in.	51 mm. 38 mm.
Standard size	3 ft. × 1 ft.	91.5 cm. × 30.5 cm.

* Expanded Plastics Ltd.

are important properties for thermal insulation purposes, and for buoyancy applications.

The mechanical properties vary with the density, but as 1¼ lb./ft.³ is typical, Table 1 is confined to details of the properties at this density.

The electrical properties are much as one would expect from polystyrene of light density. These are shown in Table 2.

TABLE 2. ELECTRICAL PROPERTIES OF POLYZOTE

Resistivity (volume after 3 mins. electrification)	$> 5 \times 10^{11}$ megohms
Resistivity (surface)	$> 10^{11}$ megohms
Breakdown strength	110 volts/mm.
Permittivity (Dielectric constant)	
800 c/s	1.05
10 Kc/s	1.05
10,000 Mc/s	1.04
Loss factor (Tan δ)	
800 c/s	< 0.0005
10 Kc/s	< 0.0005
10,000 Mc/s	< 0.0005

Expandable Granules

Polyzote granules are supplied in sealed drums, which should be kept closed at all times when the material is not being used. The maximum shelf life is then four months, but once removed from the sealed container, the granules should be used within seven days, as the blowing agent is volatile and blowing power will be lost. The material should be stored in a cool, dry place, away from radiators or open flames. It can, however, be transported as unrefrigerated cargo.

Expansion commences at about 60° C. (140° F.), and reaches its maximum efficiency at 100° C. (212° F.). If these granules are constrained within a mould, during the heating operation, free expansion can no longer take place, and the particles become sintered and thus bound to each other, and during expansion fill out all the space between themselves, taking the contour of the mould, resulting in a homogeneous moulding.

There is no restriction as to the type of shape that can be taken up, but there are various techniques which have to be observed. These will be dealt with briefly.

Pre-Expansion

Pre-expansion may be accomplished continuously for large scale production, or batchwise for smaller scale or for experimental work.

There are two convenient continuous methods.

Infra Red Heating. By infra red heating. The Polyzote expandable granules are continuously fed as a monolayer to a conveyor belt by means of a vibrating hopper. The conveyor belt carries the monolayer of granules under a bank of infra red heaters or lamps where expansion occurs. The lacy network of pre-expanded beads is readily broken up to a free flowing state. The control of bulk density is a function of heat input and belt speed, both of which may be varied to obtain optimum conditions. Careful control must be exercised as it is easy to overheat the beads, causing them to rupture. In this form they are of little use for further processing.

Steam Pre-Expansion. A safer method is to use steam pre-expansion. In this case also a monolayer of granules is fed through a vibrating hopper, on to a conveyor belt, which carries the material through a live steam cupboard suitably hooded. The time taken for this treatment may vary with the type of granule and the degree of expansion desired. The duration of contact with steam would be 1–2 minutes.

There are two convenient batchwise methods.

Batchwise pre-expansion is more suitable for the preparation of small quantities of material. This can also be carried out by means of infra red heating, but the preferred method is either by water or steam.

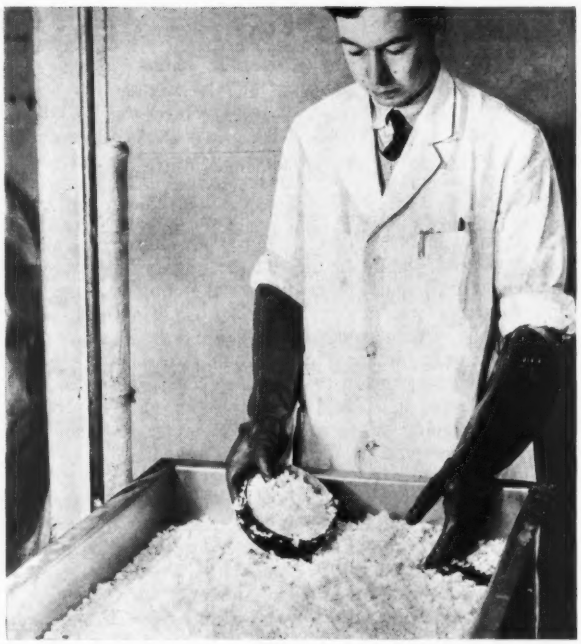


Fig. 3. Steam method of expanding granules.

Water Bath Method. Since the rate of expansion depends on the temperature of the water, tank size, rate of stirring, and other uncontrollable variables, it is not possible to lay down fixed times for any particular density.

Steam Method. This method is sometimes preferred as the pre-expansion time is shorter and the granules are more or less dry. It must be pointed out, however, that this shorter expansion time causes the expansion to be more critical. An intelligent operator soon acquires the technique, and is able to produce granules of a fairly uniform density.

In this method the granules are immersed in steam, which is generated by means of a steam coil in the water contained in a tank. A basket is located approximately 12 in. (30 cm. approx.) above the boiling water, which should not be allowed to splash on the inside of the basket. Slight steam pressure is also required, and this is obtained by placing a [illegible] metal plate over the bath, the plate acting as a lid. See Fig. 3.

A density of 1–1½ lb./ft.³ (16–20 Kg./m³) requires about 1½–2 minutes heating for correct pre-expansion, and a density of 6 lb./ft.³ (96 Kg./m³) 30–40 seconds. It is not advisable to use the steam method for densities greater than 6 lb./ft.³ (96 Kg./m³).

The pre-expanded granules should be rested for a minimum of 12 hours before final moulding, and never more than 10 days.

Mould Lubrication. A new mould should be " broken in " by painting with a silicone oil or grease (Releasil fluid from Midland Silicones Ltd.), and if possible the mould should be " baked " at 150° C. (320° F.) for two hours.

After the first few mouldings the mould should be brushed with the mould release fluid, every 10–12 mouldings (Releasil Emulsion 66, obtainable from Midland Silicones Ltd.; mica paste or soapy water may also be used with success).

By this means no sticking of the Polyzote to the mould should occur. On no account should a new mould be used unlubricated, or sticking will become a permanent problem.

Moulding or Sintering. The moulds should be packed with pre-expanded granules, taking care that all corners, shoulders, ledges, and thin edges are well filled before clamping up the mould.

The illustration in Fig. 4 shows the moulding being removed from the mould.

Cooling. Before an article is removed from the mould, it has

Fig. 4. A moulding being removed from the mould.

to be cooled, as otherwise the removal from the mould will be difficult, and even if removal is possible the moulding will swell.

The cooling cycle depends on the thickness of the moulding, but it has been found from practical experience that it is not necessary to cool the moulding to room temperature, providing this is well below the softening temperature of the polystyrene.

Low density mouldings are best cooled in air in order to avoid a chilling shock which may cause the moulding to collapse. The length of time for air cooling will depend entirely upon the thickness of the article and the mould.

Steam Injection Technique

For certain types of mouldings, particularly if these are bulky or of intricate shape, the final expansion or sintering may be accomplished by the direct introduction of steam into the mould cavity.

This is the fastest way of obtaining expansion. The substantial quantity of latent heat available in steam, causes expansion in a matter of seconds. There are two possible methods:

Using a Steam Probe. This consists simply of a drilled pipe closed at one end with $\frac{1}{32}$ in. (1 mm. approx.) diameter holes in rows spaced 90° apart. The effective steam penetration radius of a single probe is 3 in. If more than one probe is required, these should normally be spaced 5 in. apart. However, when dealing with intricate designs and large area mouldings, a closer spacing may be necessary to achieve optimum results. The steam probe is used in many applications, such as large buoyancy members, insulated wall sections, and for moulding in situ. Heating times are generally between 10–90 seconds, at pressures of 5–30 lb./in.^{2} (0.35–2.1 Kg./cm.^{2}) followed by cooling.

Fig. 5. A demonstration of the moulding technique at a recent press conference.

By Perforated Plates. This method is most generally used when making large blocks. Perforated cavity plates are backed by a steam chest integrally fastened to the cavity plates which have $\frac{1}{32}$–$\frac{1}{16}$ in. (1 mm.–2 mm. approx.) holes drilled for the passage of steam, as soon as the plates are clamped down into position.

Expansion times in these moulds may vary between 10–120 seconds, using steam pressures between 10 and 30 lb./in.^{2} (0.70–2.1 Kg./cm.^{2}) followed by a cooling cycle. The moulded article need not be cooled more than 50° C. (122° F.) before extraction.

Polyzote Insulation Boards

Owing to the closed cell structure of Polyzote, and its resistance to moisture and fungus growth, one of its main applications is in the thermal insulation field. It has the low thermal conductivity required, as will be seen from Table 1.

The efficiency of an insulation material for cold stores depends to a great extent on its natural ability to remain dry under extremes of vapour pressure differentials. Hence it is of paramount importance that all cells should be non-intercommunicating, and it is in fact, from this closed cell structure that Polyzote insulation boards derive their resistance to heat transfer.

The closed cells simulate as closely as possible the characteristics of still air. Insulation boards are made and supplied by Expanded Plastics Limited, for all insulation purposes where temperatures do not exceed 60° C. (140° F.). Food display counters, cold stores, insulated transport, walk-in cold rooms, air-ducting and air-conditioning plant are some of the many suitable applications. In many cases Polyzote has to be adhered either to itself or other materials. Suitable adhesives include E.R.C. Hot Dip X.1009, manufactured by Expanded Rubber Company Ltd., Bostik 1256, manufactured by B.B. Chemical Company Ltd., Bondastik 1310, also made by B.B., Cellobond U.8660 and J.2664, made by British Resin Products Ltd., and Flintkote CSA2 and LCB, made by Industrial Asphalte Co., Ltd. From the foregoing list adhesives can be obtained which bond Polyzote to metal, wood, cement and paper.

Polyzote boards can be punched, drilled and cut with normal wood-working tools.

Sandwich Construction

As a result of technical advances made in the past years, increasing use is being made of low density stabilizing materials for construction purposes. Owing to its high strength/weight ratio, as well as its excellent thermal insulation properties, Polyzote can be used to advantage in sandwich construction. Plywood, light alloy sheets, plastic sheeting, plaster boards, or building boards, are suitable facing materials.

Buoyancy

Polyzote is also suitable for use as a buoyancy material. Floats and lifebuoys are made from it, and Admiralty approval has already been given for its use in certain types of craft, as an alternative material to hollow metal tanks.

Finishing

Although Polyzote is of an attractive white colour, it can be coated with emulsion paints, and paints free from solvents attacking the polystyrene. It can also be finished with Snowcem, aluminium paint, plaster or cement rendering, according to requirements.

It will be seen that Polyzote is a material of many uses, and although relatively new, it is already apparent that it will be an important product of the future, and Fig. 5 shows examples of technique and products shown at a recent press conference in London.

Plastics at the Corrosion Exhibition

IT has been estimated that corrosion costs British industry somewhere in the region of £600,000,000 a year. This colossal figure is an expense that can ill be afforded by any country and it was therefore very pleasing to see the energy and enthusiasm with which corrosion is being fought as epitomized by the Corrosion Exhibition 1957. Even more pleasing was the obviously important part in the fight that synthetic materials are playing, and the equally obvious importance of these materials in future developments in the prevention of corrosion.

Constructional Materials

The use of plastics, particularly p.v.c. and glass fibre reinforced polyester resin, as a constructional material for ducting, tanks and fans has from time to time been portrayed in this journal and indeed the manufacture of these forms an important aspect of the plastics industry. B.X. Plastics Ltd. had several excellent examples in this line on their stand which featured the use of Cobex rigid p.v.c. sheet. These included a lip extraction unit and ducting manufactured by W. Canning & Co., Ltd., an electrolytic tank fabricated from Cobex expanded metal reinforced sheet by Tanks & Linings Ltd. and a model of a scrubbing tower manufactured by Prodorite Ltd.

Also showing rigid p.v.c. for fabrication were S.I.C. Plastics Ltd. who featured Sicodur and showed examples of its use.

Piping and fittings in Chemidus 2000, unplasticized p.v.c. and Chemidus H.I.20, high impact p.v.c. were featured by Chemidus Plastics Ltd. Tubing up to 15 in. in diameter for fume extraction work was a special feature of interest as was a model of an underground piping layout. Nylon, Kralastic, and Zeigler polythene were the three materials used in the piping and fittings shown by H. Incledon & Co., Ltd., who are associated with Richard E. Dupont Ltd., the manufacturers of these products. A description of the extrusion of this pipe was given in the March, 1957, issue of *Plastics*. Plastic fabrications for handling corrosive fumes were featured by the Plastics Engineering Dept. of K. W. Chemicals Ltd. who exhibited a p.v.c. lined fan, a polythene syphon and a range of polythene fittings. An interesting example of the combination of two plastics materials were some fabricated valves in which the body is moulded in polythene and the working parts made from the more rigid p.v.c. The valve is made in four bore sizes.

Non-metallic conduit and fittings extruded and moulded in p.v.c. were shown by Ega Electric Ltd. The extensive range of fittings enable a complete light and power circuit to be housed in this conduit with the consequent protection of it from atmospheric conditions as well as accidental damage. The conduit is available in six sizes and it has been found to be very effective in reducing the voltage drop on frequencies of 1,000 and 1,500 cycles. Channelling and oval conduit are recent additions to the range of accessories manufactured by this company.

The St. Helens Cable and Rubber Co., Ltd., included in their exhibit synthetic rubber, p.v.c., polythene and resin glass laminates, the latter three were shown in the form of tubing. Also showing reinforced resin fabrications were Kestner Evaporator & Engineering Co., Ltd. Fume ducting manufactured from glass reinforced polyester resin and from Keebush, a reinforced phenolic resin, was one of the principal exhibits and as an example of the type of fabrication work which can be undertaken a large fan casing in Keebush was shown.

Resins and Coatings

The temporary protection of machined metal parts from corrosion during transit and storage by dipping was demonstrated by J. M. Steel & Co., Ltd., and Croda Ltd. This latter company have recently introduced the Metavin system of chemical-resistant coatings based on p.v.c. in addition to their Crocell dip coating and Rhino Hide cold spray coating. J. M. Steel also exhibited their new polyester resin, Alkynol, and Pergut, a stable chlorinated rubber.

Permanent plastic coating by the dipping or spraying techniques was featured by Durable Plastics Ltd. who had many examples showing different types of coating. Included in the display were lengths of small diameter metal tubing coated internally with p.t.f.e.

The use of epoxy resins for metal protection was shown on several stands, Aero Research Ltd. had a comprehensive exhibit of the use of their Araldite resins for casting as well as for protective coatings. James Lithgow (U.K.) Ltd. showed their range of Calvinac coatings which they manufacture and apply. This range includes heat cured phenol formaldehyde, phenol epoxy and urea epoxy resins as well as cold curing epoxy styrene and vinyl resins.

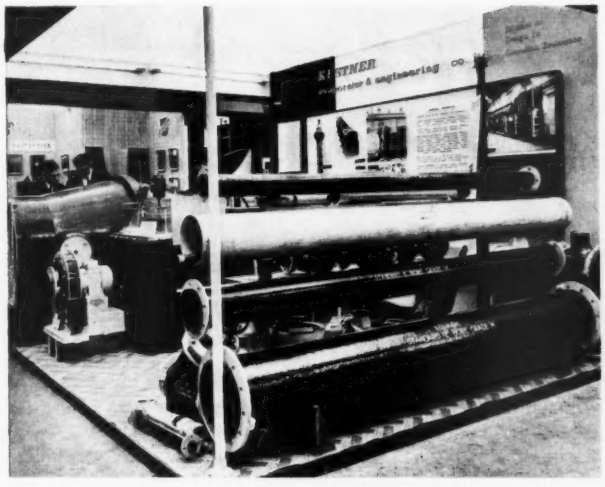
Three companies, John Gosheron & Co., Ltd., Smith and Nephew Ltd., and The Minnesota Mining and Manufacturing Co., Ltd., included on their respective stands p.v.c. tapes for pipe wrapping and for electrical insulation. Glass felt for pipe wrapping and glass cloth for use as a reinforcing material with synthetic resins or bituminous materials was shown by Regina Glass Fibre Ltd.

(Left) Valve fabricated from p.v.c. and polythene shown by the Plastics Division of K. W. Chemicals Ltd.

(Right) An electrolytic tank fabricated from Cobex expanded metal reinforced sheet by Tanks & Linings Ltd.

(Left) Fan casing fabricated in Keebush by Kestner Evaporator & Engineering Co., Ltd.

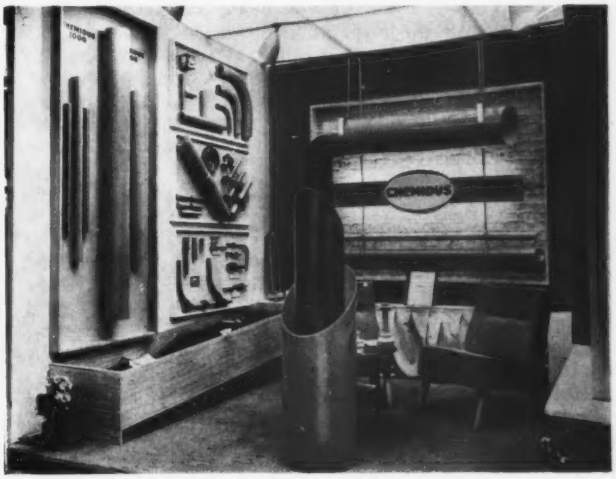
(Right) Fabricated Cobex rigid p.v.c. sheet shown by B.X. Plastics Ltd.



(Left) Ducting in glass reinforced polyester resin and Keebush shown by Kestner Evaporator & Engineering Co., Ltd.

(Right) Electrical conduit extruded and moulded in p.v.c. by Ega Electric Ltd.

(Left) Plastic coated articles exhibited by Durable Plastics Ltd.



(Right) Large extruded ducting and pipe shown by Chemidus Plastics Ltd.

Low Pressure Polythene Sheet

By S. MAJARO*

A review of the properties, methods of fabrication, and applications, of this important addition to the range of thermoplastic sheet materials

THE last two years have witnessed spectacular strides in the various forms of thermoplastic sheet fabrications. Though by no means a new development, sheet fabrication had always been the Cinderella of the plastics industry and for many years lagged behind the other methods of conversion employed by the industry. One of the major obstacles to progress was the lack of a satisfactory source of "raw materials," that is of thermoplastic sheets. Sheets of various types were available but their lack of versatility and their high cost had a rather stifling effect on the sheet manipulators. P.v.c., an excellent sheet in its own right, suffered from a few major disadvantages; a comparatively high specific gravity, a rather difficult material to mould, and high cost due to the sheet being produced by the slow and laborious pressing method. Again, polymethyl methacrylate sheet was costly both as a raw material and as far as fabrication was concerned. Thus the main object of utilizing sheet fabrication —the economic substitution of the newer plastics in place of conventional sheet metal components could not be realized.

Progress with Sheet Plastics

The turning point came with the advent of the various formulations of the rubber-modified polystyrene, or what the industry euphemistically calls high impact polystyrene—high impact when compared with general purpose polystyrene. This material, in spite of its various limitations, has brought about an extraordinarily rapid growth in the fabricating branch of the plastics industry. In fact, the terms, sheet forming, vacuum forming and thermoforming are all synonymous with boisterous advancement and progress. Hardly a day passes without the announcement of a new application made from a fabricated sheet. Polystyrene has led the field and is here to stay for it is extruded and therefore cheap; and it is light in weight and forms easily. However, high impact polystyrene sheeting which was at first regarded as the panacea for all fabrication ventures, has its limitations. It may be ideally suited for refrigeration components or T.V. masks, but it is an inadequate proposition for applications calling for high heat resistance, durability and resistance to rough treatment and to a long exposure to various chemicals.

Conventional polyethylene sheets provided a useful addition to the range of thermoplastic sheets lending themselves to fabrication but the non-availability, until recently, of extruded heavy-gauge polythene was a restrictive factor as regards cost and technical properties. Furthermore, the comparatively flexible nature of polythene necessitated, in most cases, a considerable increase in gauge in order to achieve similar results to those reached in alternative materials. The increase in thickness offset the advantage gained by the low specific gravity of ordinary polythene.

Properties of Low Pressure Sheet

The recent introduction of the low pressure polythenes has opened a new vista to the existing and would-be fabricators. These new polymers extend the use of polythene sheets beyond any applications hitherto explored in other thermoplastic materials. Low pressure polythene (alias high density, alias linear polythene, alias high molecular polythene . . . all roads lead to Rome) is heat resistant, chemically resistant, tough, machineable, weldable and very light (specific gravity 0·94). A brief comparison of the physical properties of the high and low pressure polythenes indicates an interesting correlation of such properties. The higher the density of the polymer the more the crystallinity increases; rigidity is relatively higher; softening temperatures are higher; tensile strength grows. However, elongation and impact strength normally react in inverse ratio and tend to decrease with the polymers of the highest density type. From the foregoing it will be seen that every polymer must be taken on its merits and with particular reference to the task it is expected to fulfil. As time passes and more experience is gathered of the various polythenes it will probably be found that each polymer will find its right place and uses. In the following the assumption is that a Ziegler type polymer is the basis of the sheet used and a few typical characteristics are listed to indicate the physical properties one can expect:—

(Approximate figures based on Iridon L.P.1300 extruded from a typical low pressure polythene type of polymer)

Specific gravity	0.94
Water absorption (24 hrs) (%)	<0.1
Heat distortion (66 p.s.i.) (° F.)	140
Tensile strength (p.s.i.)	3,200–3,500
Elongation (%)	300
Modulus of elasticity—p.s.i. $\times 10^5$	0.64–1.0
Modulus of stiffness in flexure (p.s.i.)	75,000–125,000
Flexural strength (p.s.i.)	2,200–2,300
Notched Izod impact strength—ft.-lb.	2.5–5.0
Rockwell hardness—' R ' Scale	32–43

Acknowledgment of Farbwerke Hoechst A.G. of Frankfurt A.M. must be made at this point; having embarked on large scale production of Hostalen, a Ziegler type of polythene, the company has proceeded with the none too easy task of educating both the end users and the fabricators in the methods and techniques of conversion. A great amount of effort and study is being directed to the fabrication of sheeting and in fact Hoechst's workshops are fabricating an enormous quantity of ducting, piping and trunking for internal use in their own factories. Proof of the company's faith in its own product, since Hoechst is introducing anti-corrosion ducting and similar items made from its own material into the various chemical plants which it operates. It is so much easier and more convincing to sell a new idea to others when one regards such an idea as being readily acceptable by oneself.

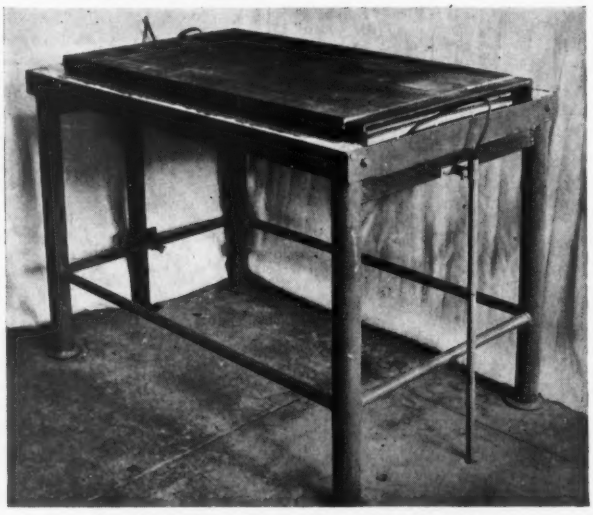


Fig. 1. The hot plate used for sheet fabrication.

* Iridon Ltd., Commercial Plastics Group.

Methods of Fabrication

Farbwerke Hoechst have evolved a whole series of tools, aids and helpers for the fabrication of low pressure polythene sheets. Great stress is laid on the butt welding technique in contradistinction to hot torch welding. The efficacy of the butt welding technique on low pressure polythene is apparent. The various ingenious devices developed by that company facilitate the handling of the sheets in the various conversion stages. The techniques recommended for welding low pressure polythene sheets are less cumbersome than hot air welding methods for p.v.c. However, a basic range of tools will have to be built by the potential fabricator of low pressure polythene. A few such tools are set out and illustrated below:—

(a) The basic tool is a hot plate which operates at an approximate temperature of 200° C., seen in Fig. 1. The two ends to be welded whether sheets or pipes, are pressed against the hot plate. When the ends have softened they are simply butted together and allowed to set. The joint thus achieved is very firm.

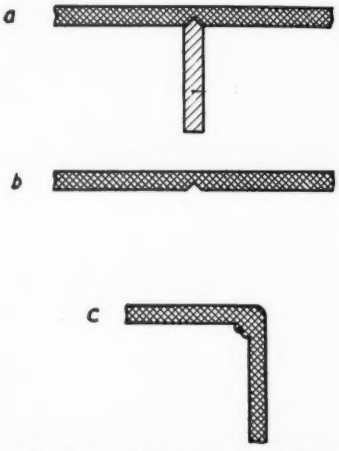


Fig. 2. Use of hot knife to bend sheet. (*a*) showing penetration of knife, (*b*) showing nick, and (*c*) showing bend obtained.

(b) Large bore pipes are being welded by a similar method but a hot ring is used for softening the pipe ends instead of a plate.

(c) Right angle bend (or any other angle bend) of sheeting. A hot knife is used here, explained diagrammatically in Fig. 2. The sheet is pressed by hand against the hot knife. When it has been nicked, the sheet is bent by hand and put into an aluminium shaped trough and water is used to cool it. The knife can also be utilized in butt welding sheets. The procedure is similar. The ends to be butt welded are held against the two sides of the knife. This is then withdrawn allowing the two ends to butt.

(d) Multiple right angle bends. Instead of one knife an adjustable bed of four knives is used. When bent into a wooden jig and allowed to set the corners butt. The ends are finally butt welded with a double sided hot knife.

(e) Flanging. Square flanges are usually made from scrap strips of low pressure polythene. These are butt welded into a frame. A hot " piecutter " is then used to groove the frame and the trunking preheated on a hot plate is inserted into the groove and allowed to set. Typical products of this technique are shown in Fig. 3.

(f) Reinforcing sheets for large trunkings. Similar to sheet metal practice; ridges are put into sheets by preheating them in an oven and then forming the ridges in one diagonal direction with a set of matched wooden moulds and then in the other diagonal direction. Examples are shown in Fig. 4.

(g) Making thin walled pipes from sheets. For this operation a sheet is preheated in an oven and is wrapped round a wooden core with cloth, as shown in Fig. 5. It is then allowed to cool. Finally the handle and bearing are removed and the wrapped up sheet withdrawn and the edges butt welded.

These are briefly a few methods which have been tested and proved successful in the production of industrial ductings, pipings, extraction fans and similar items. Other modifications of such techniques are feasible and with a certain amount of experience many improvisations can be developed. In fact one can visualise that in due course fabricators of low pressure polythene will be equipped with comprehensive sets of tools which will enable them to handle practically any combination of anti-corrosion installation. Furthermore blocks and rods of low pressure polythene can be machined by conventional methods thus complementing the range of items which can be fabricated from sheets.

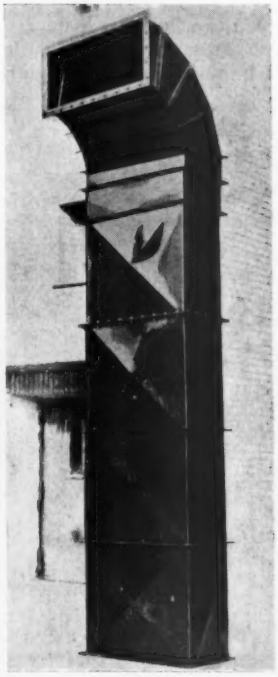
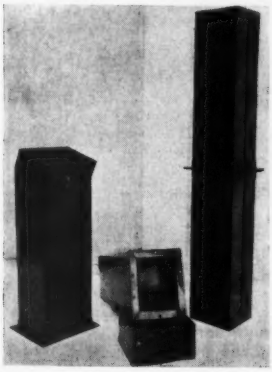


Fig. 4 (Right). An example of chemical plant made in sheet polythene.

Fig. 3 (Below). Examples of welded products in the material for the chemical industry.



Vacuum Forming

The material can be vacuum formed and it is anticipated that large quantities of sheet material will be absorbed in numerous applications fabricated by this process. The first attempt to vacuum form extruded low pressure polythene sheeting were disappointing, but with the added experience that the vacuum forming industry has recently gathered as a result of its substantial expansion, difficulties that seemed insurmountable at first seem almost trivial. An industry that has managed to produce a 13 cu. ft. refrigerator liner 20 in. deep will no doubt also find efficient methods of overcoming the poor heat conductivity and the long softening cycle of low pressure polythene.

Most vacuum formers will find that a slight modification of their equipment is essential in order to achieve satisfactory results and on an economic basis. This applies especially where heavy gauges are called for (.060 in. upwards). The major modification to be recommended is the installation of a double-heater. The object of such a heater is twofold: it accelerates the heating cycle by softening both sides of the sheet in one operation; and it ensures that both sides get consistent heating. Extruded low pressure polythene sheets, when heated, tend to corrugate, thus creating uneven softening due to the crests of the corrugation being nearer the heater. As a result the soft zones thin excessively when the material is drawn on to the mould. On the other hand when two equi-distant heaters are utilized this difficulty can be overcome. Infra-red heaters produce more satisfactory results than other conventional heaters. As in vacuum forming generally the correct heating of the sheet and the right kind of heater are all important.

The incorporation of a double heater necessitates certain structural changes to the vacuum forming machine especially in those models where the sheet is clamped to the moulding box.

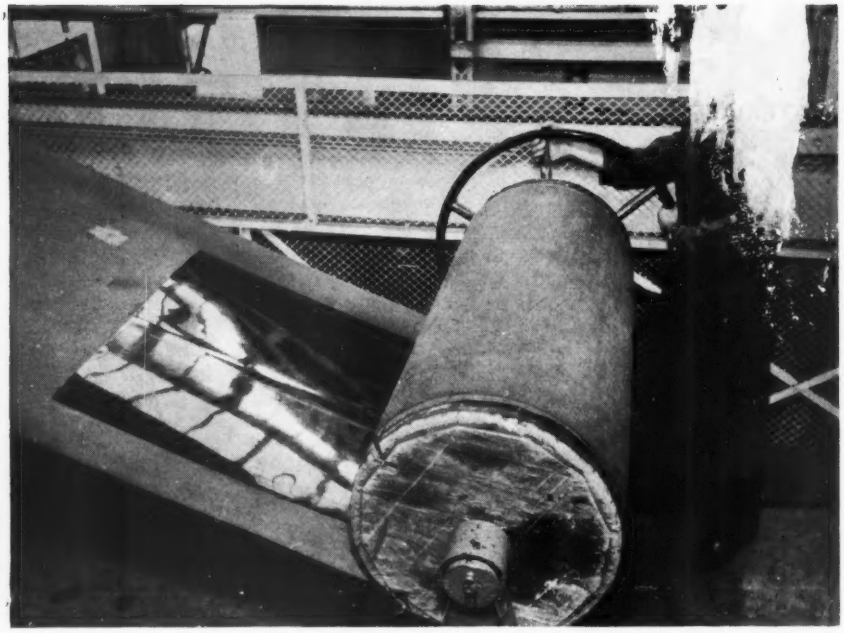


Fig. 5. Machine used for the fabrication of thin-walled tubing.

The availability of an airslip attachment on the machine in conjunction with the double-heater is a great advantage.

Where the inclusion of the above refinements is not a feasible proposition the fabricator will have to resort to makeshift methods. In the case of comparatively thin gauge sheets (0.040 in. —0.080 in.) a partial evacuation will suck the sheet on to the mould and continued heat plus continued vacuum will force the sheet into the mould. Alternatively, the sheet can be heated for a while, then unclamped and turned over on its other side and heated again.

Owing to the many outstanding properties of low pressure polythene and especially its chemical inertness, this type of sheeting is ideal for industrial ducting and ventilators. At present this is the largest outlet for low pressure polythene sheet and it is envisaged that large quantities will be absorbed in this field. It is perhaps unnecessary to stress that industry will find this type of installation more economical in view of the fact that rust and corrosion will not shorten the life of such plants.

Special Applications

It is envisaged that Iridon L.P.1300 will open entirely new fields of application owing to its special characteristics. These applications will cover practically every facet of industry and will offer an exciting challenge to the vacuum former and the fabricator. For heavy industry, trolley bodies, tote boxes, and various containers offer immediate investigation. Packs for military equipment, such as radio transmitters can be vacuum formed easily and cheaply, and where the pack has to be carried, low pressure polythene's low specific gravity will offer additional advantages. Containers in food processing factories will also offer considerable scope, owing to the lightness of the material, the fact that it can be sterilized and absence of corrosion.

This would also apply to such articles as fish boxes which have to withstand considerable rough usuage. An added advantage, where these are used on the quayside is that should such an empty container fall into the water it would float, the material being lighter than water.

Canopies over large kitchen ranges are another outlet as such a canopy could be fabricated entirely of low pressure polythene thus reducing the cost of heavy fixtures and eliminating rust due to condensation.

Lighting fittings and fixtures, either vacuum formed or fabricated, for commercial use offer a vast potential, especially where these are subject to maltreatment.

Owing to its high melting point low pressure polythene can be considered for such articles as sink units and various hot liquid vats. Its application for moulds, for the various jelly and confectionery processes is also an extremely interesting one, since apart from the heat distortion factor, the inertness of the material allows easy removal of the cooled confection from the mould. The use of the material for shuttering in the building industry would have advantages over the present materials in that it is virtually unbreakable; on building sites and construction yards this is an important point.

Certain types of commercial vehicle seats might be vacuum formed, and this may offer the vehicle manufacturer interesting lines of thought for the future.

Other ideas that spring to mind are washing machine liners, baby baths (Fig. 6), animal feeding troughs, manger liners and various components where toughness, strength and heat resistance are required.

In conclusion, it is the author's conviction that low pressure polythene sheet will offer far greater scope to the progressive fabricator than has any other thermoplastic sheet in the past.

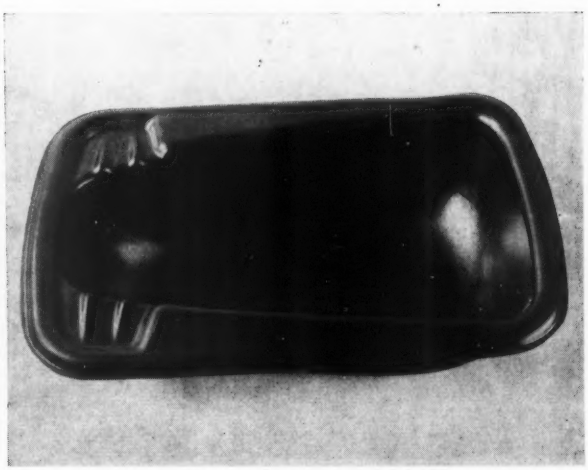


Fig. 6. Baby bath vacuum formed in low pressure polythene sheet.

...orld's Industry Employs Plastics

M... ...l and TESTING

Properties and uses of polypropylene.—A review by G. Coppa Zuccari of the preparation, properties and uses of the plastic "Moplen," developed by the Montecatini concern. The reviewer enumerates the characteristics of types 1 and 2, the former being of low molecular weight and suitable for films, whilst the latter of higher molecular weight is suitable for injection mouldings, pressings and extrusions. Special attention is given to the relatively high temperatures at which this resin may be used, namely 150° C. The S.G. is about 0.9 so that it floats. Numerous illustrations are given of its uses, such as sanitary ware, basins, netting, electrical equipment and others.

(*ION—Rivista Española de Quimica Applicada*, 1957/July/363.)

Resistance to formaldehyde.—Phenol-formaldehyde and other resins may be graded very good or good as regards their resistance to formaldehyde according to the amount of fillers or plasticizers which they may contain. Hard p.v.c. is resistant to 50% formaldehyde solutions up to 71° C. Up to 25° C. vinyl/vinylidene chloride copolymers as for example Saran, Velon or Permalon are also resistant. Fibres of 90% vinyl chloride/10% vinyl acetate copolymer tend to shrink in formaldehyde to a degree depending on the temperature. Polyester resins are resistant to 40% formaldehyde up to 93° C. and reinforced with glass fibre, are used for containers for this chemical. The epoxy resin "Synthetesine 200" is resistant to 37% formaldehyde solution. Polyacrylnitril—vinyl chloride (Dynel) does not shrink in 40% formaldehyde solution at 50° C. and loss of strength is below 5%, but some slight discolouration occurs. Providing construction is such as to support the material against the effects of heat, polyethylene is resistant to formaldehyde solutions up to 107° C. The silicone resin "Nubelon 5" is resistant to formaldehyde. Plexiglas, even at temperatures as low as 21° C. is not resistant to formaldehyde. PTFE is absolutely resistant to formaldehyde and together with neoprene can be used as a sealing material in apparatus handling formaldehyde. In this account, E. Lingnau, besides dealing with plastics, presents also a comprehensive account of the reactions of structural metals with formaldehyde gas and solutions.

(*Werkstoffe und Korrosion*, 1957/August-September/480.)

Structure of polythene.—In a brief summary of a paper read at the 132nd A.C.S. National Meeting, the molecular structure of polythene is discussed with some new ideas put forward as a result of work carried out by Tennessee Eastman chemists. Branch chains and molecular weight are two important factors discussed.

(*Chem. & Eng. News*, 1957/September 23/64.)

Antioxidants in polythene.—A precis of a paper given by W. L. Hawkins, of Bell Telephone Laboratories, gives details of the use of antioxidants together with finely divided carbon black in polythene to provide heat and light stability. Thio-β-naphthol, one of the sulphur compounds tested protects carbon black polythene for 1,000 hours at 140° C. as compared with the best current formulation which stands up for less than 200 hours under the same conditions.

(*Chem. & Eng. News*, 1957/September 16/86.)

Stress cracking in low pressure polythene.—A discussion on formulation and fabricating techniques which have to some extent eliminated stress cracking in Ziegler polythene was given by F. H. M. Tigue at the 132nd A.C.S. National Meeting. On the same subject Kurt Richard, of Farbwerke Hoechst, discusses the West German custom demanding a 50-year guarantee for high pressure potable water pipe. To meet this demand it is claimed that the low pressure polythene of increased molecular weight has been developed which has been pipe tested for 25,000 hours at room temperature with a pressure of 710 p.s.i. Orientation of the molecules, Richard claims, has not been sufficiently considered as a possibility for increasing pipe strength.

(*Chem. & Eng. News*, 1957/September 16/98.)

INDUSTRIAL APPLICATIONS

Immersion Electrodes for measuring contents of tanks in ships.—Walter Krebs summarizes the requirements of an electrical measuring device for supervising and controlling the contents of ships' tanks containing electrically conducting fluids. The device described consists of a lead electrode projecting from a watertight Vinidur sleeve. The apparatus described is intended to operate at 12 volts and it is specified that the Vinidur tube must be long enough to ensure that no false readings occur due to surface conduction through films of dirt or condensed moisture forming on the plastic. Various designs of indicating instruments and electrical circuits are briefly summarized.

(*Schiffbautechnik*, 1957/August/473.)

Industrial Effluents containing chromium.—At a symposium organized by "l'Association Française pour l'Étude des Eaux" on May 2, 1957, G. Allais of the Association read a paper on effluents resulting from metal treatment. He referred briefly to the development of a synthetic ion-exchange resin resistant to oxidation by hexavalent chromium. This, it is suggested, may make it possible to recirculate such chromium-contaminated waters. Other appropriate resins may be used to recover copper and cyanides. The author is unable to find an example of the use of ion-exchange resins for treating effluents in France.

(*L'Eau*, 1957/July/134.)

Plastic finishes for leather.—This note deals with the finishing of upper leathers for the boot and shoe trade and is itself abstracted from another foreign source. It summarizes briefly the effect of the addition of other substances used in the finishing of leather upon synthetic resins also applied as finishes. Thus it is shown that the effect of an addition of more than 15% of casein finish is to lower the extensibility of a butyl-acrylate/butyl-methacrylate mixture, whilst a film of this plastic becomes brittle with additions of 30% of casein. Additions of wax + casein have less marked effects. This butyl resin is stated to be stable to ultra-violet light. Polymethylmethacrylate has an extensibility twice that of the butyl polymer, but 10–20% of casein addition causes this value to drop by 50–80%. Polymethylmethacrylate is less affected as regards extensibility by heat than the butyl compound. A mixture of polymethylmethacrylate and dibutyl phthalate (9 : 1), is less affected by wax-casein mixtures than the two preceding resins. The article concludes with a reference to the effect of pigment additions (TiO_2 dispersed in casein) on resin finishes for leathers.

(*Revue Technique des Industries du Cuir*, 1957/September/199.)

MISCELLANEOUS USES

Fuse design.—An account by Bernhard Heydenreich on the practical aspects of fuse design (in metals and non-metal) for military shells and grenades. The author deals with service requirements and materials of construction. Particular reference is made to early difficulties involved in developing the AZ23 type fuse constructed as a phenolic-resin moulding, mineral-filled to bring its weight up to that of corresponding designs in metal in order to retain balance in the projectile. A form of steel, basket-like reinforcement was eventually evolved which, in the AZ23Pr, proved eminently satisfactory. The author notes the necessity for low cost and refers to the limited use of injection-moulded plastics on account of the quantities involved.

(*Wehrtechnische Monatashefte*, 1957/Feb./58.)

Container for experiments with explosives.—In his researches on the behaviour of liquid explosives under mechanical and thermal stress, Zibbermayr investigated the conditions under which these substances became ignited on subjection to the action of various types of missile. In one such experiment, nitroglycerine, and dinitrobenzene in nitric acid were, respectively, contained in freely suspended Mipolan foil bags, measuring about 8–10 cm. cu. These were shot at with small spherical steel missiles. Though conditions were so adjusted as to produce extreme pressures (locally, up to 10,000 atm.) when the missile struck, even at velocities up to 1,000 metres a second ignition did not occur although the explosive solution was atomized.

(*Explosivstoffe*, 1957/September/195.)

Fabricating Sheet Plastics

There is a steadily growing demand for prototype and other items fabricated to engineering standards. Precision work with sheet plastics at the factory of a London company is described here.

THERE has been an increasing demand during the post-war years for the small scale production of plastics articles such as are not readily nor economically produced by the normal methods of injection and compression moulding. Such articles may vary in size from small engraved illuminated dials, to large mechanical components which require machining from sheet or block.

This work often calls for a degree of precision such as is usual in general engineering practice, and indeed, may be required to form part of a particular engineering concept or project, and hence it is necessary that the initial approach to the work be in line with that of the main design, which may not accept as final the generally accepted limitations of the materials to be employed; this frequently being so in the case of pressure cylinders, large volume tanks, etc., where orthodox methods of working may not provide a sufficiently broad basis for the production of the particular job required.

It thus often becomes necessary to employ a wide range of engineering and other techniques to the plastics material which may be most favourable to the work in hand, and by combining these methods, with the advantages of the particular material, such as the shaping propensities of acrylics, to produce satisfactorily the parts required.

A firm which specializes in this type of work is Talbot Designs with works in North London. While employing normal modern methods in the fabrication of thermoplastics sheet, this firm, which was started in 1946 as a design and prototype service, has since become primarily interested in the production of work where precision, size, or an unusual application is the dominant factor.

Development Work

A great deal of development and pilot work is carried out, such as the making of prototypes of items to be made eventually by normal plastics quantity-production methods. These include parts of consumer goods such as refrigerator, motor and television components, and some of the development work may call for extremely close tolerances (in some instances a total tolerance of .001 in.). Such work naturally requires close control of temperature in working and measuring, this temperature necessarily being such as is acceptable to the conditions in which the component is to play its part.

Chemical plant and allied equipment is also produced by Talbot Designs, and here again can be seen the application of orthodox steel fabrication to those techniques usually associated with sheet plastics, the result of which is to allow a broader conception of the possibilities of the material used, and it is quite usual for various materials to be used in juxtaposition, so that one may be complementary to the other as distinct from employing separate components fashioned in different materials.

Talbot Designs recently completed, in Perspex, the electro-decanters for use in the new Fluon plant of Imperial Chemical Industries Ltd., at Hillhouse, Lancashire, and these, being part of a large engineering concept fell into the category of work alluded to above.

It may be of interest, at this stage, to give some indication of the variety of jobs of an unusual nature which have been produced by Talbot Designs thereby indicating the wide scope of work which occupies their interest.

The largest job, both in complexity and conception which has been produced to date is, undoubtedly, the full scale model of a Fordson Tractor, illustrated in Fig. 1, and this work demanded a combination of diverse techniques in order to produce the many components required to complete the whole.

These components ranged from precision built pumps, hydraulic gear, power take-off drives, etc. (these being made strictly to production drawings) to complexities of shaping and fabricating sheet. It also became necessary to produce the equivalent of a casting which might then be worked by the normal methods of turning, milling, etc., into a complete replica of the standard component, and on the closeness to which this "Casting" followed the original, depended, very largely, the success of the finished job.

The technique of building up such a "casting" in acrylics may be briefly summarized as follows:—

First the sheet stock is cut to size and annealed in order to release the stresses in the material; this is desirable in order to minimize the potentiality to craze during subsequent lamination or build-up.

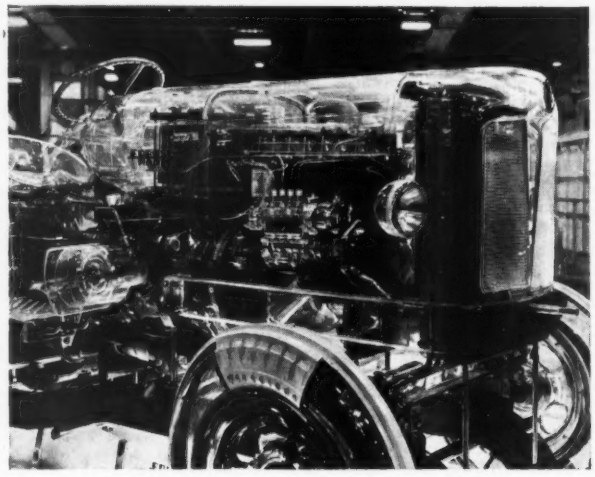


Fig. 1. Perspex replica of a Fordson tractor.

The various pieces necessary to complete the form are then laminated or built on in order of precedence by the use of Tensol No. 3 cements, made to an appropriate mix, polymerization by ultra-violet light being carried out at each stage.

Upon completion of this assembly stage, polymerization of the whole is rendered final by heat treatment and the job is then machined to completion in the usual way. It may be necessary, however, to alternate the machining with the addition of further parts to the casting and where parts are to be built on to, or adjacent to, machined surfaces, the whole job is re-annealed in order to release surface stresses set up by machining. Eventually the total build-up is completed and machining can proceed to completion. An excellent example of precision engineering in Perspex is shown in Fig. 2.

Recently a commission was received for a Perspex body to be fitted to a Triumph T.R.3 sports car and this was completed within a period of 12 weeks. On this particular model, owing to the fact that a number of inner panels had to be omitted in order to facilitate vision, the problem of suspending the body on the chassis became a formidable difficulty which it was necessary to resolve in such a fashion as not to depart visually from the orthodox method of fixing employed on the standard production car.

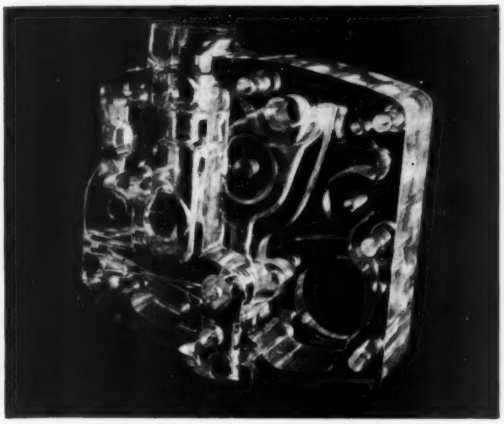


Fig. 2 (Left). An hydraulic control unit, precision engineered in Perspex.

Fig. 3 (Right). The Triumph TR2 front end, made by Talbot Designs for the Motor Show.

To produce the type of work which this car body illustrates, it is necessary to retain almost entirely the techniques normally associated with the shaping and fabrication of this particular type of sheet, although some slightly unorthodox tooling is required in order to render the whole economically practical.

The main difficulty in this type of job lies, not in the forming of the many body parts and components (and these are legion in the modern car) but in relating these to the chassis or frame of the model to be shown. A restyled version of the Triumph front end is shown in Perspex in Fig. 3.

Here a great deal of ingenuity is needed to resolve the differences in dimension caused by the departure from thickness standards as used to make such a body in pressed steel, and it thus becomes necessary, on some panels, to encourage the greatest possible sheet shrinkage, while others must be machined below standard size in order to fit the component in.

This method of encouraging shrinkage is used in preference to the building of undersize tools in order that standard steel body panels may be incorporated in the tooling, thus saving considerable expense on the tooling of such work. This procedure has been employed with considerable success on a great number of jobs which are normally produced in sheet steel, thus encouraging a great deal of exhibition work which would otherwise be economically impracticable.

Sheet Fabrication for Structural Purposes

Although constructional work has been carried out in the U.S.A., utilizing corrugated acrylic sheet, bolted together and supported by steel or timber framework, it may well be that the construction recently built by Talbot Designs for the General Electric Co., Ltd., was unique. This structure was required to be an extension, to an existing building in orthodox materials, and was in essence, a projection of this building.

The width was approximately 26 ft., and depth of projection from the existing structure, approximately 8 ft., with a height from the existing floor of almost 10 ft., the whole fabrication being based on a 42 in. radius, and consisting of Perspex sheet welded together without any support other than that of the material itself. The fabrication included a corner tower and covering dome of 84 in. diameter, and the whole was constructed from $\frac{3}{8}$ in. thick sheet, cold welded with Tensol No. 3.

Shaping of the sheets, and prefabrication of various parts, was carried out in the works, and then transported to the site, for final erection.

Although this structure occupies an exceptionally exposed site, and a number of gales were experienced during erection, the whole project proved to be completely satisfactory.

General Applications

Other items which have aroused interest are: Stilling boxes for sewage disposal plant, which basically are Perspex cylinders, 12 ft. to 15 ft. in diameter and some 8 ft. high. These were produced for an extremely up-to-date plant at Tunbridge Wells, and the job included erection on site, a not infrequent occurrence, since installation of this, and other types of industrial plant, are often an integral part of the job.

A two and a half times scale model of a fuel injection pump, with its diversity of closely machined parts, was made for display purposes, and replicas of various engine parts are almost always in production, for a number of vehicle and engine manufacturers. Two complete 3 in. centrifugal pump units, complete with ducting and glands, etc., were recently made for display and development work, and also a large number of 44-gallon oil-drums made in Perspex, for Shell Petroleum Ltd.

Most large display models are, of course, required to be made in Perspex, but some very large and intricate work is also produced in p.v.c. and polythene, for industrial use. Examples include acid absorption columns, 8 ft. high by 3 ft. diameter, fabricated in p.v.c., large and complex developing tanks, water treatment plant, etc.

Mathematical engraving, dividing, etc., of dials and panels, represents another sphere of interest, and very large plotting tables are engraved on Perspex, for use on warships.

A number of large Perspex hemispheres and domes (up to 56 in. diameter) are also produced, these being used for a variety of purposes, as for firing control turrets on warships, radar domes, and cover guards for bottling machinery, and, of course, display purposes.

Oversize display models of all kinds have been produced, including 6 ft. high Lucozade bottles, wine glasses and a 20 ft. by 9 ft. replica of a jelly " mould." Perspex and Cobex is used to fabricate and mould letters for shop fascia signs, and these are made in a variety of founts and sizes.

Small quantities of fluorescent lighting fittings are produced, such as may be required to complete a particular scheme or a single installation.

The items described above represent the day to day work which is carried on in this establishment and are not by any means exceptional. In consequence of this almost every job is one which requires special consideration as to the methods to be employed in its accomplishment and although complex tooling is often required to produce perhaps one single item improvisation must play a great part.

The type of plant needed for this type of work must necessarily consist of the basic engineering machine tools together with those usually associated with sheet fabrication; and versatility is, of course, the first requisite in any tool.

The wealth of experience gained by Talbot Designs in this branch of plastics fabrication is utilized by the various Ministries (including U.K.A.E.A. and A.W.R.E.) and a large number of nationally known concerns. Indeed, it would be difficult to name a field of industry for which this firm does not cater in some small but vital manner and the illustrations accompanying this report indicate the range of components manufactured so far.

New Productions

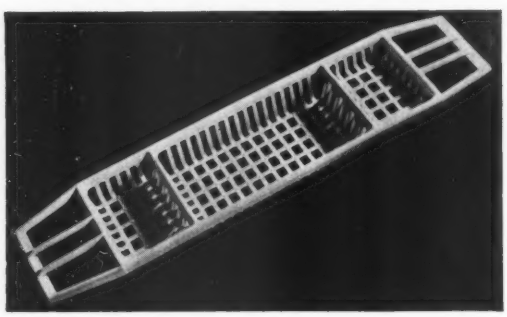
(Left) Moulded acetate artificial fingernails manufactured by Pendry (Plastics) Ltd.

(Right) A large porous filter manufactured in Teflon p.t.f.e.

Artificial Finger Nails

Amongst the many applications of plastics in the cosmetic and pharmaceutical industries one is of particular interest as an example of accurate and skilful moulding. Our illustration shows artificial finger nails injection moulded in cellulose acetate by Pendry (Plastics) Ltd., Bridge Works, Brentfield Road, London, N.W.10. Outward appearances suggest that as the moulding is a comparatively simple form so will there be no difficulties in producing it but this did not take into account the superlative finish and the dimensional accuracy required. An additional factor in their production is colour matching which for obvious reasons is important.

It is to the credit of the moulder and to the marketing organization, Eyelure Ltd., of Welwyn Garden City, that a considerable proportion of these finger nails are exported.



(Left) A recent new product from O. & M. Kleemann Ltd. is the injection moulded polythene bath rack illustrated.

New Caravan

A new 22 ft. family caravan, in which polyester/glass fibre laminates are widely employed, is now being manufactured by Thomas Hosking Ltd. (Thurston Street, Cardiff).

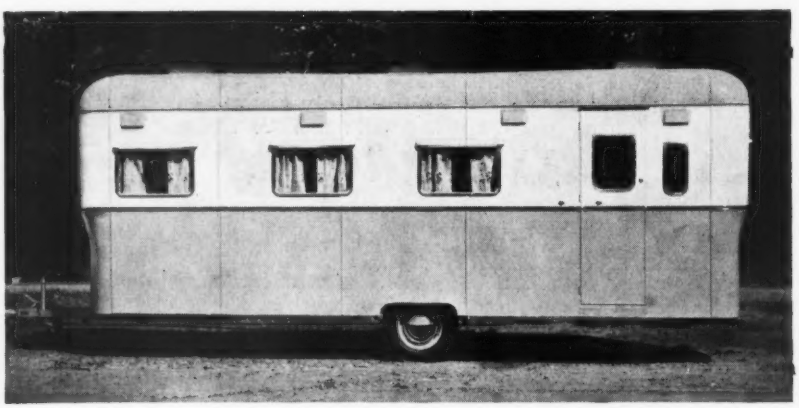
The new caravan, which is called the "Sunquest," is of exceptionally elegant design. Cellobond polyester resins manufactured by British Resin Products Ltd. are used throughout and full use is made of the many special properties of these resins when employed with glass fibre as a constructional material.

The roof, the three amber coloured vents and the end sections are all moulded in this material. The exterior of the caravan is painted although the polyester/glass components being completely weatherproof do not need protection. The bodywork is mounted on a steel channel and angle chassis and is designed so as to remain balanced and secure during towing.

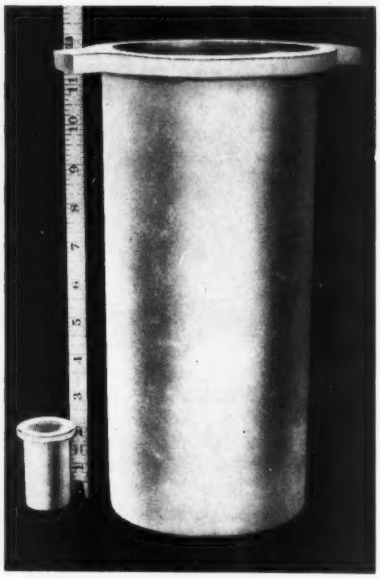
Inside the caravan the chair arms, the head boards, the built-in lockers and all items involving curvature work are also manufactured from polyester/glass.

Careful control is maintained over every stage of manufacture. A hand lay-up technique is employed in the construction.

Because of the extensive use of plastics in its construction the "Sunquest" weighs only 30 cwts., and is the lightest caravan of its size and class. Normally four berth, it is easily converted to sleep five, and can be towed by a 16 h.p. car.



(Right) The "Sunquest" 22 ft. caravan.



Large Porous Teflon Filter Cups

Porous Plastic Filter Co., Inc., a Pall Filtration Company of Glen Cove, N.Y., announces the availability of what is believed to be the largest moulded porous cylindrical filter cup of Teflon.

The larger filter element in the photograph is 12 in. high with 5½ in. o.d. and 5 in. i.d.

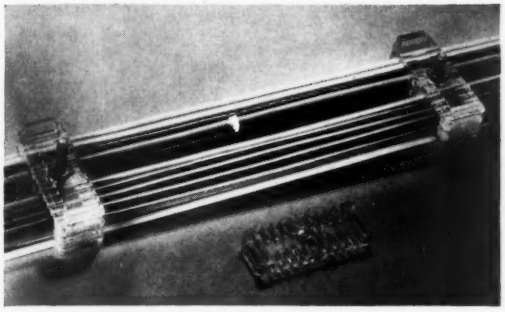
Though such filter cups are normally completely porous except for the mounting flange, the large cup has been made porous in the lower 7 in. only: this in a single moulding operation.

The smaller unit is 2¼ in. high with 1¼ in. o.d. and 1 in. i.d. Intermediate sizes can be made also.

Designed to meet the requirements of an atomic energy application, this filter is rated to remove from suspension essentially all particles over 3 microns in size.

Since porous Teflon retains all the corrosion resistant properties of solid Teflon this large filter cup makes possible the design of larger filters for plant scale clarification of corrosive liquids.

Teflon is the trade name of E. I. Du Pont de Nemours & Co. Inc. and refers to polytetrafluoroethylene.



(Left) Moulded polystyrene cable clips made by Creators Ltd.

(Right) Vidor torch with a p.v.c. case for insulation and shock resistance and an injection moulded polystyrene lens.

Cable Holding Clip

A new form of cable clip is now being marketed by Creators Ltd., of Woking. This clip which is called the Huckepack consists of interlocking polystyrene mouldings, which can be built up to a depth of up to 10 layers and fastened to a baseboard or chassis by a single bolt.

The clips are available in four sizes to suit different types of cable. Apart from the obvious advantage of rapid and easy assembly of cable forms, these clips by virtue of the fact that they are built up in three dimensions as opposed to the usual two dimensional layout, allow a very large number of cables to be carried in a very small space.

A further advantage is that the cable layout can quickly be changed if required and cables can easily be traced without the use of conventional identification systems.

A New All-plastic Curtain Rail

What is believed to be the only all-plastic curtain rail in the world available with roller runners was on show for the first time at the 5th Handicrafts and Do-It-Yourself Exhibition at Earls Court. The rail is manufactured by Tubeway (Sales) Ltd., of Brompton Road, London, S.W.3.

The spherical nylon runners of this new curtain rail are built into a tubeway of extruded rigid p.v.c. All working parts are thus enclosed and are consequently kept clean.

The plastic tubeway in which the nylon runners glide is supported by moulded brackets of high impact styrene.

The whole assembly is stainless, rustless and washable and is designed for fitting to wall or ceiling.

Laboratory tests have been carried out which showed that the rail will not break even under severe loading conditions—heavier than any curtain could be. The stops at the end of the tubeway to prevent the rollers coming off are so designed that the harder they are hit by the rollers as the curtains are pulled open, the tighter they fit.

Three to 8 ft. lengths of the already assembled tubeway curtain rail are packed in a polythene lay-flat tube, heat sealed at either end.

Each bracket is made to take valance extensions should they be required as an extra. They are simply plugged into holes provided in the bracket and are designed so that the valance rail can be fitted into slots in the extension.

Coated Fabric for Wall Covering

Arlington Plastics Development Ltd., Harlow, Essex, are marketing a special range of vinyl coated fabrics for wall covering, panelling, display and mural work generally.

This new range will be known as Mural Texturide, and consists of three of the most popular designs from the Texturide upholstery range together with three new additions designed especially for this type of work by Tibor Reich F.S.I.A.—Firenze, Linette, and Hopsack.

Each of the designs in the photograph is available in a wide colour range and may be obtained in rolls of approximately 25 yards × 50/51 in. width direct from the manufacturers or from stockists. Cut lengths are also available from certain stockists.

Polyethylene Film in Building Construction

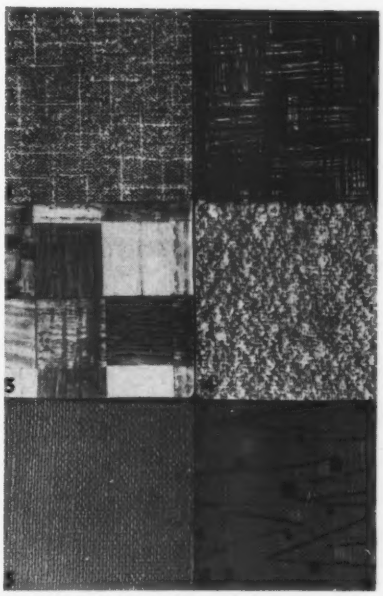
Nearly an acre of transparent film made of Union Carbide polyethylene, stapled to temporary wooden frames, was used to protect open areas and speed construction of a new 20-story office building for an American firm. The flexible, light weight film was easily attached to the frames and held in place with strips of lath. By shielding with film made of Union Carbide polyethylene, the contractor prevented freezing of plaster and concrete during the coldest days.

Approximately 40,000 square feet of the tough, moisture-resistant film also protected workmen against weather conditions and permitted construction work to continue when it would normally have been halted by rain, snow, high wind and freezing temperatures. Since this film is transparent, enough daylight is transmitted so there is less need for artificial lighting. Its good insulating qualities retain heat inside the building and help provide comfortable working quarters during winter months. In addition to heat and light savings, the low-cost film is considerably less in price than conventional cloth shields. After a job of this kind is completed, lumber used for the frames can be re-used on another project.

Large Epoxy Castings

Furane Plastics Incorporated has been successful in developing liquid epoxy systems and safety hardeners for large mass potting of transformer insulation and for the casting of electrical insulating bushings weighing in excess of 100 lb. Cast bushings have demonstrated outstanding dielectric properties and are unique among epoxy resin formulations in the fact that they are obtained with high dimensional accuracy, very low shrinkage and very low internal heat during cure.

(Left) A selection of brushes made by the Kleen-e-ze Brush Co., Ltd., incorporating nylon monofilaments. Cellulose acetate and polystyrene have been used for several of the handles.



(Above) Six designs of the coated wall covering produced by Arlington Plastics Development Ltd.

Plastics News

Plant and Equipment, Materials, Processes, Company News, Technical Literature, Exhibitions, Personal Notes and Meetings.

NEW ALL-PURPOSE SAW BENCH.—A saw bench has been introduced which is capable of cutting any wide variety of materials without difficulty and providing a completely clean edge. This is the sizing and trimming circular saw WA80 now available in this country from Messrs. Guilliet Sons & Company, Limited, 28–30 Rivington Street, London, E.C.2. This machine will cut laminated plastic, acrylic resin sheet, fibre glass, aluminium faced plywood, rubber, toughened plywood and practically every material which the modern fabricator is faced with.

The saw is a high precision instrument and all operations are controlled by adjustable stops with calibrated scales.

The normal speeds of the WA80 are 4,800 and 6,500 r.p.m., but other speeds are available up to 10,000 r.p.m. to suit the kind of materials being cut and the saw blade being used.

The double-roller carriage runs accurately between large, dust free rollers, and the cross slide is made of a new light alloy which can be readily suspended and also removed from the machine by one man.

General

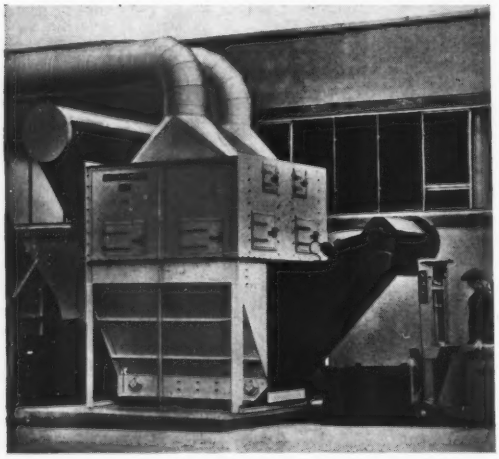
Hydraulic Elevating Trolley.—Farrow & Jackson Ltd. are now marketing their new hand-operated hydraulic elevating trolley. Robust yet very easily pushed around it is very reasonably priced. The standard model has a top area of 33 in. × 21 in., it is 29 in. high and in its fully raised position extends to a height of 48 in.

It will lift loads of up to 8 cwt. to the full height of 48 in. in 35 seconds and is so light in operation that the handle can be pumped by one finger which means that female labour can more than cope. Lowering is achieved by giving the handle a half turn in an anti-clockwise direction. Clips are provided for housing the handle when not in use and it is fitted with two fixed and two swivel wheels. Standard finish is in deep bronze green but other colours can be had to special order.

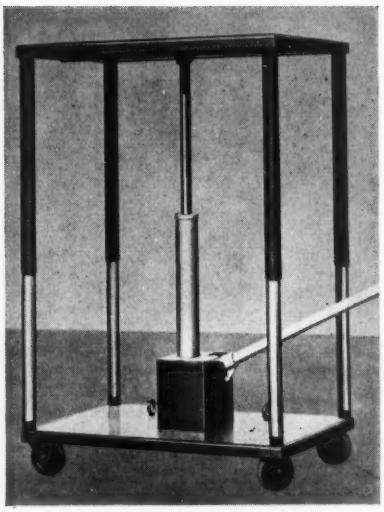
Modifications for Testing Equipment.—Modifications applicable to equip its T-50 State-of-Cure Tester for Temperature Retraction and Brittleness tests, are announced by Scott Testers, Inc., Providence, R.I. Originally designed to determine the state of cure of elastomeric compounds at temperatures of – 50° C. to – 65° C. in accordance with A.S.T.M. Specification D599–55, T-50 testers already in use are easily equipped by users' personnel with the new modifications. One of these permits testing specimens for temperature retraction at – 70° in accordance with A.S.T.M. D1329–54T and the other performs brittleness evaluation at necessary temperatures for compliance with A.S.T.M. D746–55T. New owners may obtain the T-50 testers with either or both of the modifications, or add them subsequently. Further details can be obtained from Scott Testers, Inc., 161 Blackstone Street, Providence, R.I.

A New Design of Self-Induced Spray Type Collector.—Dallow Lambert have produced a new range of self-induced spray type wet dedusters, specified series MG, which are now available in 13 standard sizes ranging from 2,000 c.f.m. – 48,000 c.f.m. capacity. The deduster, which has been critically tested in the company laboratories followed by extensive site evaluation, is available with four principal methods of sludge removal, being extremely adaptable in this respect.

No pumps, nozzles, high speed rollers or other mechanical spray producing equipment is employed, so avoiding wear and chokage normally associated with such equipment when dealing with sludge or slurries. Considerable attention has been devoted to the provision of automatic controls to ensure optimum operating efficiency under all conditions and to reduce water consumption to a minimum.



The Dallow Lambert MG.160 wet deduster.



Hand operated elevating trolley.

Export Orders for Plastics Equipment.—An order for £54,000 worth of plastics machinery and high pressure fittings has been obtained by the Burtonwood Engineering Co., Ltd., of Warrington, Lancashire, from the Royal Dutch State Mines.

The whole of this equipment is for the manufacture of polythene—a new development for the Royal Dutch Mines.

Another recent order obtained by the company is for £28,000 worth of plastics equipment from France. These goods are for a new Normandy plant of the Ethylene Plastique organization.

Imports of Machinery from the Dollar Area. The Board of Trade announce a modification in the arrangements for the grant of import licences for machinery from the dollar area. Applicants will no longer be asked to indicate whether an alternative machine is obtainable from non-dollar sources outside the United Kingdom. There will be no change in the present requirements that the dollar machine must reduce costs and that no alternative United Kingdom machine offering roughly similar advantages is available.

New P.V.C. Flooring.—The Adamite Co., Ltd., of 94–98 Petter Grance, London, S.W.1, makers of "Vynoleum" pure p.v.c. domestic flooring and "Altro" and "Altro Safety" p.v.c. industrial floorings, have added a new type of flooring to their range. Called "Varitone," it is like the rest of their range in that it is made from pure p.v.c., but it is available in two-colour combinations, with an inlaid contemporary "vermiculated" design. Like "Vynoleum," it is smooth finished, and is felt-backed.

Metal Box Reduce Prices of Diothene Bulk Produce Bags.—The Metal Box Company announces that it has reduced by approximately 12% the price of its standard bulk produce bags made of Diothene. These are punched bags sized 20 in. × 36 in., made in 250 gauge Diothene, which are used for distributing pre-packaged produce in bulk. They will hold ten to eleven 5 lb. packs of potatoes, or twenty-three 3 lb. potato packs, or thirty-five 20 oz. carrot packs, or forty-five 1 lb. carrot packs.

At the same time the Company is now producing a 20 in. × 34 in. bag at a lower

price; this bag has roughly the same capacity as the larger bag. Both of them meet the demand for a cheap non-returnable container, which keeps the contents clean and is attractive in appearance.

Second Trans-Atlantic Telephone Cable.—The manufacture of over 2,200 nautical miles of the submarine telephone cable required for the second trans-Atlantic project for laying between America and France by the American Telephone & Telegraph Co., Ltd., has been entrusted to Submarine Cables, Ltd., owned jointly by Siemens Edison Swan Ltd. and The Telegraph Construction & Maintenance Co., Ltd.

The design of the cable is substantially the same as for the first trans-Atlantic cable. The inner core consists of polythene extruded over a central copper conductor composed of a 0.131 in. wire surrounded by three tapes 0.0145 in. thick. Over this core, which is 0.62 in. diameter, is applied the outer conductor consisting of a layer of six copper tapes applied with a long lay and held in position by a copper binder tape and a protective fabric tape, both applied with a short lay.

Salon de l'Emballage.—Machines Dubuit of Paris exhibited two new screen printing machines at the Salon. The first was a semi-automatic silkscreen machine for printing on small conical objects, such as aluminium or tin bottle closures, conical plastic containers.

The machine works on the revolving turret principle, the operator feeding the objects and removing them manually, the action of the squeegee being automatic. The production rate is up to 2,000 prints per hour. The thickness of ink deposited gives perfect impressions even when printing white on black.

The machine works on the principle of the development of the cone (the screen movement follows a path corresponding exactly the cone's development), there is, therefore, no slipping between the screen and the object, thus giving clear and sharp definition even on very small type matter. Range, 2 in. to 2 in. diameter.

The second was a semi-automatic silkscreen machine for printing on cylindrical as well as flat metal containers. This machine has been specially designed for those manufacturers who require for the packaging of their own products a considerable amount of containers of different shapes, cylindrical and flat, the individual quantities were, however, insufficient to warrant the installation of separate machines.

On the machine change-overs from one size to another and from one shape to another are speedily effected and outputs of up to 1,500 objects per hour can be obtained. The machine works on the same principle of the existing hand-operated machine for cylindrical objects (No. 11), the screen carrier is, however, driven by a motor and the intervals between printing, loading, etc., are controlled by time switches, the motor is fitted with an electric brake, thus ensuring the immediate and positive stopping required. Cylindrical range up to 4 in. diameter, flat range up to $11\frac{1}{4}$ in. $\times$ $7\frac{7}{8}$ in.

The Lesto electric hand saw cutting a sheet of asbestos.

Mobile Laboratory Unit for Epikote Resins.—A mobile unit from the Egham Technical Service Laboratories of Shell Chemical Co. is now on tour in the Midlands demonstrating the applications of Epikote resins in the engineering industry.

Many British firms are already using these resins with success for press tools and foundry patterns. Other firms, who may be less familiar with the technique for making resin tools, can now take advantage of this unit which will give demonstrations on their own premises.

The unit will be used to show how these new petroleum derived resins can be used to make foundry patterns which are accurate and durable. "Epikote" resin copy patterns can be prepared from a wooden master far more quickly and cheaply than similar metal patterns. Short-run press tools and vacuum forming moulds can be cast from the resins simply and easily. Unlike metal cast tools, little or no finishing is needed.

It is hoped to extend this service in future to cover the rest of the country. Companies wishing to know more details should apply to the Shell Chemical Sales Office in their area.

The Shell Epikote mobile unit.

Device for Cutting Shapes.—To meet the demand of the building, woodworking and plastic trades, Trend Industrial Equipment Ltd., 5 The Ridgeway, Stanmore, Middlesex, have devised and produced an attachment for the Swiss-made "Lesto" Electric Hand Saw (Type GEB 11), a power tool with a power rating of 200 watts which operates from any standard supply of 200/250 volts A.C./D.C.

The normal capacity of this saw is $1\frac{1}{2}$ in. in timber, $\frac{1}{2}$ in. in aluminium and $\frac{1}{4}$ in. in steel. With the addition of our special curved footplate attachment, which can be fitted in 30 seconds, the machine will cut shaped material much more easily than has been possible hitherto. The same footplate can also be used for cutting flat materials. As an indication of the cutting speed, the 6 ft. by 4ft. sheet of "Big Six" asbestos illustrated was cut in under $1\frac{1}{4}$ minutes.

Revision of Tolerances for Trade Weights.—The Board of Trade propose to revise the tolerances laid down in the Weights and Measures Regulations, 1907 (S.R. & O., 1907, No. 698), for weights in use for trade purposes.

The proposals cover weights of the avoirdupois, grain, troy, apothecaries, metric and metric carat series. Details of the proposed revised tolerances may be obtained from: The Controller, Standard Weights andMeasures Department, Board of Trade, 26 Chapter Street, London, S.W.1.

Vinyl Monomers.—Koch Laboratories announce the availability of the following new monomers:— 1. Vinyl Toluene (Methyl Styrene); 2. Vinyl Xylene (Dimethyl Styrene); 3. Vinyl Mesitylene (Trimethyl Styrene); 4. Alpha-Vinyl Naphthalene.

These are potential building blocks for a series of new polystyrenes, and are particularly valuable for Research Departments interested in producing new polymers with outstanding properties.

Further information can be obtained from Koch Laboratories, 46 Britton Street, London, E.C.1.

Literature

Dermatitis and Epoxide Resins.—A technical memorandum issued by Bakelite Ltd., 12–18 Grosvenor Gardens, London, S.W.1, gives case

histories and handling precautions which are advisable for the control of dermatitis likely to occur when using epoxide resin systems.

Fibreglass Reinforced Plastics.—A revised edition of this booklet by Fibreglass Ltd., Ravenhead, St. Helens, Lancs, has been issued. The booklet contains information on reinforcement materials, moulding techniques, design properties and applications.

Melamine for Surface Coating.—Technical Bulletin No. 3 issued by British Oxygen Chemicals Ltd. deals exclusively with the preparation of melamine resins for surface coating. The Bulletin describes three methods for the preparation of butylated melamine.

Pipe Fittings.—A leaflet prepared by Horwitch Smith & Co., Ltd., of Pensnett, Brierley Hills, Staffs, gives details of their range of Oxythene high impact p.v.c. pipe fittings.

Russian Articles.—Translations of the following articles will shortly become available from the Department of Scientific and Industrial Research, Regent Street, London, S.W.1: CTS 384; The role of diffusion in the mutual adhesion of high polymers: CTS 391; Ageing of high polymers: CTS 371; The polymerization of propylene in the presence of phosphoric acids containing fluorine and boron fluoride. T.C.L. No. 96; The question of utilization of polymer materials on the basis of p.v.c. for production of means for individual protection from radioactive radiation. T.C.L. Nos. 98 and 99; Investigation of the process of hardening of phenolformaldehyde resins I and II. Investigation into the effect of chemical structure on adhesion.

Unpublished Reports.—Copies of the following reports may be obtained on application to The Department of Scientific and Industrial Research, Lending Library Unit, 20 Chester Terrace, Regent's Park, London, N.W.1.

Quantitative analysis of elastomers through the infra red spectra of heir pyrolyzates: PB.121115. A semi-quantitative method is described for determining polymer blends and co-polymer ratios from the infra red spectra of their pyrolyzates (distillates). The method was established through the analysis of phenolic resin blends in Buna N rubber, and by determining the percentage acrylonitrile in butadiene acrylonitrile co-polymers.

Molecular motion in methyl silicones and chlorosilanes at very low temperatures: PB.122088. Measurements made of the proton magnetic resonance absorption of various methyl siloxanes and methylchlorosilanes at 4° K. to room temperature confirm the presence of considerable molecular freedom in all but the polymethyl cyclosiloxanes. Even at 4° K. rigid lattice values are not obtained owing to rotation of the methyl group about its C_3 axis.

Plasticized modifications of dipropylene glycol castor oil-m-tolylene diisocyanate polyurethane as potting resins: PB.122144. The addition of 10% by weight of dioctyl sebacate to the 16.7% dipropylene glycol-modified castor oil-TDI-potting reactants produced a considerable reduction in initial viscosity and a longer working time due to the lower rate of reaction and viscosity increase.

An investigation of some of the physical properties of rod-like and coplaner polymers such as polyphenyl: TIDU.5246. The preparation of polyphenyl and the determination of its equivalent weight and transference number is described in detail. Work on the electrical conductance of polyphenyl in pyridine-water solutions at 50° C. is also discussed.

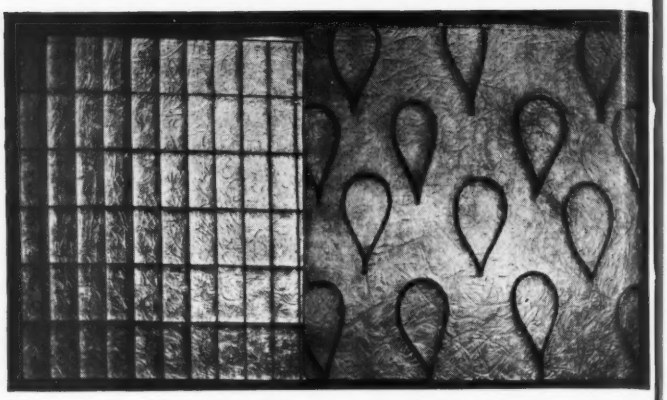
Thermal degradation of various polymers over the range 300–600° C.: TIDU.5360.—The results are given of thermal degradation studies in which residues of high carbon content were obtained by heating certain polymers in air, but phenolic resins showed relatively low weight losses at 600° C. in nitrogen. Other materials which were studied included chlorinated linear polymers, melamine-formaldehyde resins, polybenzyl and its naphthalene analogue and polyphenylenes prepared by Wurtz synthesis from di- and trichlorobenzenes.

Some applications of infra red spectometry to the qualitative analysis of plastic materials: TIDU. 5365.—An example is given of the practical results obtained from the application of infra red spectrum analysis combined with fractional precipitation to the study and analysis of some of the more commonly used plastic materials, and of the nitro and the synthetic lacquers.

How to Choose an Extruder.—This bulletin has been prepared by the Prodex Corporation of Fords, New Jersey, U.S.A., and contains much interesting comparison and criticism on the design features of different extruders. As is to be expected, because the bulletin has been designed fundamentally as sales literature, the Prodex extruder receives favourable comment but the comparison of different features nevertheless provides interesting reading.

Fluon.—A series of pamphlets on the use of Fluon, polytetrafluoroethylene have been issued by the Plastics Division of I.C.I. at Welwyn Garden City. Also from the same source is a pamphlet on Melinex polyester film.

The Management of Design.—The Council of Industrial Design has published "The Management of Design," a report on the International Design Congress which it held in London in September last.



New decorative structural panel made by Martin Goacher & Co. Ltd., from Bakelite polyester resin reinforced with glass fibre material.

Company News

Aldersley Agencies Ltd. have moved to new offices at 32, Buckingham Palace Road, London, S.W.1. Telephone: Victoria 5721.

Negri Bossi & Co. have moved their management, technical and commercial services to 24, Via Bazzini, Milan.

Stewarts & Lloyds have formed a new subsidiary company, Stewarts & Lloyds Plastics Ltd. This new company will initially manufacture and sell low density polythene tube.

Wellington Tube Works Ltd. are installing extrusion plant so that they can supply plastics tube as the demand arises.

The Central News Ltd. have moved to new premises at Pemberton House, East Harding Street, London, E.C.4. Telephone: Fleet Street 9681.

V. & E. Plastics Ltd.—Mr. S. Friedland, Director of V. & E. Plastics Ltd., Macclesfield, advises us that the vinyl products of their company are in such demand that they are moving to larger premises on December 2, 1957. Coincident with the move, they will operate as Frido Ltd., at Victor Works, Brewery Street, Portwood, Stockport, Cheshire. Telephone: Stockport 7581.

The compression and injection moulding side of their business will remain in Macclesfield, with the revised address: V. & E. Plastics Ltd., Park Lane, Macclesfield, Cheshire. Telephone: Macclesfield 4476/7/8.

Griffin & George Ltd., the laboratory furnishers, announce that the address of their sales office and warehouse for the Birmingham Area is now Frederick Street, Birmingham, 1 (Central 2552). Also, the telephone number of their Edinburgh Office at Johnston Terrace is now Caledonian 4868.

Klockner Moeller England Ltd. have continued their expansion programme by opening offices in the Midlands and North-East England on November 1.

The new premises are at Guildhall Buildings, Navigation Street, Birmingham, 2 (Telephone: Midland 2891), and 451 Durham Road, Low Fell, Gateshead-on-Tyne, 9, Co. Durham (Telephone: Gateshead-on-Tyne 77035).

Burtonwood Engineering Co., Ltd.—Following negotiations in the United States the Burtonwood Engineering Co., Ltd., of Warrington, Lancashire, is to extend its range of plastics reducing equipment.

For the past three years the Company has been producing the Burtonwood–Cumberland Stair Step Dicer in various sizes under licence from the Cumberland Engineering Co. Inc., of Pawtucket, Rhode Island.

Mr. H. V. Rowlands, Director in charge of the plastics machinery division of the Burtonwood Engineering Co., Ltd., visited Pawtucket and has returned with further licensing arrangements. These will enable his company to make a range of equipment which, it is expected, can meet all the requirements of plastic manufacturers.

Catalin Corporation of America and Cie Centrale Rousselot, 50 Rue Boileau, Paris, France, will exchange technical information

Winning display at the 1957 Minibition.

and " know-how " under the terms of a five-year licence agreement announced today by Harry Krehbiel, president of Catalin. The agreement provides payment for Catalin on a royalty basis.

James North & Sons, Ltd., and James North Export Ltd., of Hyde, Cheshire, and London, leading safety product manufacturers in Europe, have merged with **Jomac Incorporated** of the U.S.A., to form what is believed to be the largest protective glove and clothing concern in the world.

The new U.K. company known as North–Jomac Ltd. will make and distribute Jomac products in this country, in Europe and in Commonwealth countries such as Australia, New Zealand and South Africa. The new American company, Jomac–North Incorporated, will manufacture and sell North products in the U.S.A. Above the 39th parallel, James North Canada Co., Ltd., is owned equally by both Jomac and North.

Tootal Ltd. announce they have purchased the whole of the share capital of **Thermo-Plastics Ltd.,** of Dunstable, and of its associated company, Plastra Components Ltd., of Welwyn Garden City.

Thermo-Plastics Ltd. was founded in 1932 by its present managing director, Mr. A. Reingand, to manufacture fascia letters, signs and display equipment from plastic sheet.

Mr. Reingand remains with the organization, which will continue to have available the benefit, not only of his long experience, but also that of the existing personnel.

The Companies have factories at Dunstable and Welwyn Garden City and employ over 500 people. Expansion has been rapid during the past few years and it is now intended to start production at a branch factory in St. Helens, in order to serve the growing requirements of the Company's northern customers.

This extension of Tootal interests into the field of plastic products follows on the purchase of Vetrona Fabrics Ltd., a concern specializing in the manufacture and finishing of fabrics containing glass yarns. Tootal have collaborated with the West Point Manufacturing Co. of Georgia, U.S.A., in the production of non-woven fabrics by Lantor Ltd. The long term future of each of these branches of production is inter-related in that they all depend, to some extent, on developments in the fields of fibres Research organization.

Colour Sprays Ltd. have moved to new premises at Albion Works, North Road, London, N.7. Telephone: North 6091/4.

Omni (London) Ltd. announce that they have been appointed the exclusive agents for the J. T. Baker Chemical Co., Phillipsburg, New Jersey.

Lacquer for Polyester Panels.—The Durez Plastics Division of the Hooker Electro–Chemical Co. have developed the above specially compounded lacquer formulation, which, when applied to Polyester glass panels, multiplies their weathering life.

Data sheets and prices can be obtained from the sole United Kingdom distributors, Messrs. Omni (London) Ltd., 35 Dover Street, London, W.1 (Telephone: Hyde Park 9451), who can also arrange for samples to be dispatched direct.

Saro Laminated Wood Products Ltd. announce that they have acquired the complete sheet extrusion equipment of Messrs. Ashdowns Ltd. The addition of this plant, to the machines already operating " round the clock " at Saro's Cowes factory, will provide increased output of Saroy high impact polystyrene sheeting and reduce delivery times.

The Company does not custom form Saroy sheet but its technical service laboratories are always available to assist sheet users and all companies enquiring for formings are put directly in touch with firms who specialize in this work.

Winston Electronics, Ltd., Shepperton, Middlesex, have been appointed sole United Kingdom Agents for a number of industrial electronic control instruments manufactured by Beckman Instruments, G.m.b.H., Munich, Germany, and Beckman Instrument, Inc., Fullerton, California, U.S.A.

Rhoden Partners Ltd. have recently moved to much larger premises at 29 Park Crescent, London, W.1 (Tel.: Langham 7488).

Polypenco Limited announce that they have recently opened an office and factory in Tewin Road, Welwyn Garden City, and are now in a position to supply from stock, nylon rod, tube, strip, plate and other shapes. The Company also manufacture p.t.f.e. in a variety of shapes and formations.

Polypenco Ltd. is the British subsidiary of The Polymer Corporation of Reading, Pennsylvania.

Exhibitions

The Sixth Factory Equipment Exhibition, to be held at Earls Court, London, next April 14–19, will have as its theme: " Modern Factory Equipment—Britain Challenges the World."

The Engineering, Marine, Welding and Nuclear Energy Exhibition will be held from Thursday, April 16, to Thursday, April 30, 1959.

Exhibit at Amsterdam Macroplastic Fair.—The British Plastics Industry stand is the largest national exhibit at the International Macroplastic Fair, Amsterdam, which is to be held from November 13 to 20, 1957. The stand, built by the British Board of Trade, will be staffed by representatives of member companies of the British Plastics Federation. All exhibits on the stand will be provided by the British plastics industry. Emphasis will be given to the production of technical products from British plastics materials.

Conferences

The Institution of the Rubber Industry, and The Plastics Institute.—The Institution of the Rubber Industry and the Plastics Institute are holding their first Joint Conference on Thursday, February 27, 1958, probably in the building of the Institution of Civil Engineers, Great George Street, Westminster, S.W.1. The subject will be: " Recent Advances in Polymer Technology." There will be two general lectures, and parallel sessions of papers in the morning and afternoon.

Further details will be issued in due course.

The European Congress of Chemical Technology, 1958, will take place in conjunction with the Achema Congress, 1958, in Frankfurt (Main), from May 31 to June 8, 1958.

Personal

Mr. Dennis J. Hardwicke has been appointed general manager of Metal & Plastic Compacts Ltd. (Plastics Division), motor cycle accessory manufacturers of Small Heath, Birmingham, in succession to the late Mr. Jan Roll.

A portrait of Mr. H. V. Potter, Chairman of the Board of Bakelite Ltd., painted by the eminent artist Mr. James Gunn, A.R.A., R.P., LL.D., was unveiled on Thursday, September 26, 1957, by Mrs. Potter in the presence of the directors and a few guests. The photograph shows Mr. and Mrs. Potter with Mr. James Gunn (left) in the Board-room shortly after the unveiling.

Mr. D. Grant.

Dr. S. J. Skinner.

Mr. T. E. Laing.

Mr. J. Formo.—The Society of Plastics Engineers, through its President, Mr. Peter W. Simmons, has appointed Mr. Jerome Formo chairman of a special committee to develop plans for the formation of a Plastics Institute. This Institute would serve the Plastics Industry in much the same way as the Textile, Rubber, Glass, Steel and other basic product institutes serve their respective industries.

The Plastics Institute will provide facilities for research both fundamental and development, education for those in any branch of the Industry and an unparalleled library for reference and study. All segments of the Plastics Industry—fabricators, material suppliers and equipment builders will benefit from the Institute, and, of course, will be invited to participate in its programme and facilities to serve the Industry.

For further information, contact Mr. Jerome Formo, Chairman of the Plastics Institute Committee, 2753 Fourth Avenue South, Minneapolis 8, Minnesota.

Mr. R. A. Kinnes, who has been for many years a Director of Courtaulds Ltd. and Financial Adviser to the Board, has expressed the wish to relinquish his Directorship on attaining the normal retiring age of 65.

With much regret the Board have accordingly accepted his resignation with effect from September 30, 1957.

Mr. P. S. Rendall.—In order that he may be free to give more time to his many other duties, Mr. P. S. Rendall has relinquished his seat on the Board of Lustre Fibres Ltd., of which he was also Chairman. He is succeeded as Chairman by **Mr. D. Rawlinson,** who continues as a Managing Director.

Lustre Fibres Ltd. are the overseas distributors of Courtaulds' yarns, fibres and plastics F.N.F. machinery; and British Nylon Spinners' nylon yarns and fibres.

The Electrical Research Association announces that, as from October 1, 1957, **Mr. L. Gosland** has been appointed Research Manager of the Association and **Mr. E. E. Hutchings** head of the Member Relations Department. **Mr. A. M. Cassie** and **Dr. L. H. Orton** will be joint heads of the Switchgear Department, and **Dr. G. Mole** and **Dr. F. Busemann** head and deputy head respectively, of the Transmission and Utilization Department.

Mr. Douglas A. Dew, who has been in the service of Barrow Hepburn & Gale Ltd. for 20 years and General Manager of its activities in conveyor and transmission belting for the past five years, has joined the Board. Mr. Dew is a Member of the Council of the Federation of British Rubber and Allied Manufacturers' Association.

Mr. David Grant has joined the staff of Bone Brothers Ltd., Alperton, to take charge of the Development and Technical Sales of their extrusion equipment. Mr. Grant, who was formerly in the Technical Service and Development Department of I.C.I. Ltd., Plastics Division, has had a wide experience in the extrusion field and has been the author of a number of papers on the subject.

Mr. Percy Watts.—It is with regret that we hear that Mr. Percy Watts passed away on Sunday, September 29.

He joined the Bowthorpe Electric Co., Ltd., soon after the Company was formed in 1936 and latterly managed the Sales Department and also the Cable Accessories Division of Hellermann Ltd.

Mr. A. H. Thomas, chief buyer of British Belting & Asbestos Ltd., has been elected Chairman of the Purchasing Officers' Association. He joined the Association in 1946 and later was elected Chairman of the Yorkshire Branch. For several years he has been a very active member of the National Education Committee.

Mr. E. A. O. Mange.—Mange Plastics Ltd., a subsidiary company of the Tube Investments Group, announce with regret that Mr. E. A. O. Mange has resigned his position on the board.

Mr. D. M. Woodford has been appointed to the Executive of Scott Bader & Co., Ltd., as Technical Service and Sales Manager, Polymer Section. In this position Mr. Woodford is responsible for handling the technical development and sales of materials for the surface coating industries.

Dr. S. J. Skinner and Mr. T. E. Laing have been appointed to the Board of British Geon Ltd.

Dr. Skinner has been associated with the plastics and rubber industries since 1930 and has written a number of papers on plastics and rubbers. For his research work on rubber he obtained the degree of Ph.D. in 1932. During this period he became an Associate of the Institute of the Rubber Industry.

Dr. Skinner joined Distillers in 1945. In 1946 he was appointed Sales Development Manager of British Geon Ltd. and became General Sales Manager in 1954.

Mr. Laing, who joined the Distillers Group in 1943, has been Works Manager and more recently General Manager of the joint British Resin Products Ltd./British Geon Ltd. factories at Barry, Glamorgan, since they were built from 1947 onward.

Mr. John Kenneth Dick, Joint Managing Director of Mitchell, Cotts & Co., Ltd., has joined the Board of The British Xylonite Co., Ltd.

Mr. R. K. Turner has been appointed president of Bakelite Co., Division of Union Carbide Corporation. He succeeds Mr. George C. Miller, who has been appointed president of Union Carbide Realty Co.

Golf Results.—The results of the P.I.G.S. meeting at Moor Park Golf Club were: "Airbourne" Trophy, winner: F. T. Fletcher, 35 points; runner-up: G. F. Hunt, 33 points. Cyril Last and Major Knowles Trophies, winners: C. Parkinson and G. R. Clarke, 31 points; runners-up: J. R. Severn and P. Morgan, 31 points (after a tie, best first nine holes).

Mr. Arthur Waddington has been appointed an Executive Director of Universal Metal Products Ltd. **Mr. E. G. Wertheimer** is the Managing Director.

Appointments to National Research Development Corporation.—The President of the Board of Trade has appointed **Major Richard Miles** and **Sir Owen Wansbrough-Jones** as part-time members of the National Research Development Corporation for three years, and has renewed the part-time appointments of **Prof. P. M. S. Blackett, Mr. J. F. Lockwood** and **Sir Rowland Smith** for a further two years, and of **Sir John Duncanson** for a further one year.

Meetings

November

19th.—"The Flow Properties of Polythene and their Effect on Fabrication," by P. L. Clegg. The London Section of the Plastics Institute, The Wellcome Building, 183–193 Euston Road, N.W.1. 6.30 p.m.

20th.—"Developments in Butadiene Copolymers," by N. D. MacLeod. The North-Eastern Section of the Plastics Institute, the Second Dining Room of the Eldon Grill, Grey Street, Newcastle. 7 p.m.

21st.—"Polyurethanes," by L. N. Phillips. Joint Meeting of the Society of Chemical Industry, Plastics and Polymer Group with the Liverpool Section S.C.I. at Preston.

29th.—"The Machining and Finishing of Plastics," by B. E. Terry. The North-Western Section of the Plastics Institute, the Engineers' Club, Albert Square, Manchester. 6.45 p.m.

December

4th.—"Reinforced Alkyd Moulding Material and its Application," by G. Bell. The North-Eastern Section of the Plastics Institute, the Second Dining Room of the Eldon Grill, Grey Street, Newcastle. 7 p.m.

6th.—Seventh Annual Dinner Dance of the Western Section of the Plastics Institute, at the Queen's Hotel, Cheltenham. 7.30 p.m.

11th.—"Use of Rubber and Plastics in the Cable Industry, with particular reference to desirable new materials for telecommunication wires and cables," by K. H. Whitlock. Joint meeting of the South Wales and Monmouthshire Sections of the Plastics Institute and the Institution of the Rubber Industry, at the Angel Hotel, Cardiff. 7 p.m.

11th.—"Mechanical Handling," by A. E. Homes. The East Midlands Branch of the Incorporated Plant Engineers, the Sherwood Room, County Hotel, Theatre Square, Nottingham. 7 p.m.

Automation Equipment

Feeding Hopper Type N.235.—The Feeding Hopper Type N.235 will deliver small articles, at rates up to 6,000 per minute, in single file and with sufficient space between articles to enable them to be counted electronically. It will handle disc-shaped objects of sizes from $\frac{7}{16}$ in. to $1\frac{3}{8}$ in. in width and from $\frac{1}{16}$ in. to $\frac{7}{16}$ in. in height.

A photocell and lamp are incorporated and counting is achieved by arranging for the light beam falling on the photocell to be interrupted once by each item as it passes. Every interruption causes the photocell to generate an electrical impulse which is then applied to an electronic counter.

Two delivery chutes are fitted on the hopper and articles can be diverted from one chute to the other by means of a solenoid-operated flap. When containers are required to be filled automatically with given quantities, the flap solenoid is actuated by the output relay of the Batch Counter Type N.808. This counter can be set to operate on any desired number, and immediately this total is reached the stream of articles will be deflected from one chute to the other. After the next batch total has been reached the articles will be diverted back to the original chute. A full container can thus be replaced by an empty one whilst another is being filled and the process can be continued indefinitely.

One of the features of the hopper is the ease with which it can be adjusted to deal with different sizes of articles. Two gauges are provided, one for height and one for width, and adjustment for a change in article size is effected by simply closing each gauge until it just grips a sample of the new article. The height gauge is varied by means of a knurled knob on the top of the hopper, whilst the width gauge, which is friction loaded, is adjusted by simply sliding it to its new position. The delay entailed in a change of article size is, therefore, normally only a matter of seconds.

Airmec Ltd., High Wycombe, Bucks.

A New Process Timer.—A new self-resetting synchronous timer has been added to the Rodene range. It is designed for through panel mounting and, except for a small steadying screw, is a one-hole fixing.

It employs the instant-start, self-clutching Rodene timer motor which makes possible the simple method of operation shown in the adjoining cut-away view of the new unit.

The spring marked E normally holds the arm A against the stop C which is positioned by the control knob. The instant the timer is switched on the arm begins moving counter-clockwise, the gearing in the motor being such that it takes the time indicated on the dial to reach the " O " position where it depresses the actuator D of a heavy duty micro-switch.

If the motor is now left energised it will come to a standstill, but will hold the switch operated. When the motor is switched off its integral clutch opens allowing the spring to reset the switch immediately and restore the arm to its normal position against the stop ready for the next cycle.

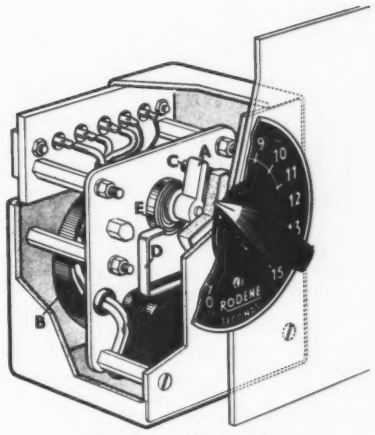
There are four standard models, providing ranges of 0–15 secs.; 0–60 secs.; 0–5 mins.; and 0–10 mins. Due to the low stalled current and torque the first two models can be left " timed out " with the switch actuated for as long as required.

The two longer period models each have a built-in relay arranged to reset the mechanism at the end of the timed period and to hold a contact operated during the " timed out " period thus providing effectively the same action.

The output switch has change-over action and is rated at 3 amps: at 450 v. A.C. and 5 amps: at 250 v. A.C. Motors are wound for most standard voltages and frequencies.

Accuracy is high as the special motor always reaches synchronous speed in about two cycles.

D. Robinson & Company, 58 Oaks Avenue, Worcester Park, Surrey.



The Rodene Process Timer

Automatic Panel Controls Weights, Sequence of Scale-to-Mixer Routing.—Automatic feeding, weighing and delivery of ingredient to any of a series of mixers is controlled from a fully automatic " memory panel " that does not need an operator.

The system is designed to integrate automatic weighing operations to a series of mixers, completely electronically. A small control panel is installed for each mixer in the system, and mixer operators dial requests through these panels to the main " memory panel. "

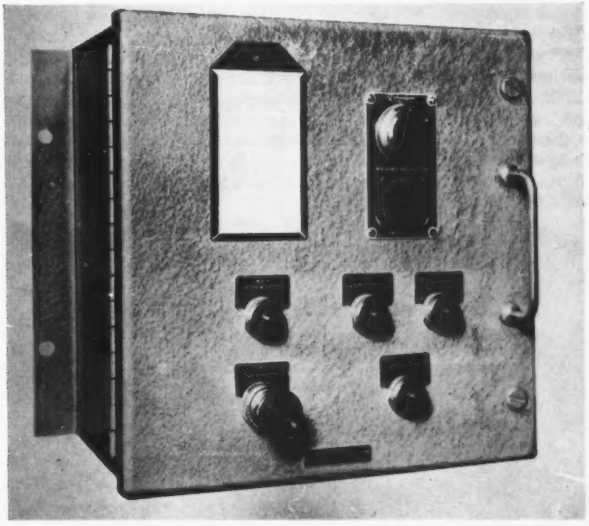
Besides controlling exact weight of each request and routing the weighing to the right mixer, the main panel keeps track of the sequence in which requests were received, and makes weighings and deliveries in that sequence.

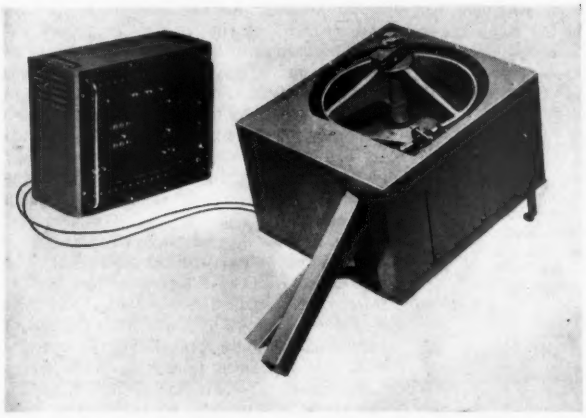
The system is designed for manual as well as automatic operation. Manual operation requires an operator at the main control panels, to sequence the material by push button controls through feeding, weighing and delivery operations.

Richardson Scale Co., Van Houten Ave., Clifton, N.J., U.S.A.

(Right) The main "memory panel" of the automatic weighing and mixing unit of the Richardson Scale Co.

(Below) The Airmec counting and feeding hopper Type N.235





TALKING SHOP . . .

Thermo - Plastics Ltd. Following the announcement that Tootal Ltd. had acquired the whole of the share capital of Thermo-Plastics Ltd., I visited Mr. A. Reingand, the managing director, at Dunstable. This change in ownership has been made to secure the future of Thermo-Plastics, particularly from the standpoint of expansion, and also to enable Tootals to enter more directly into the activities of the plastics industry.

This year is the 25th anniversary of Thermo-Plastics Ltd., and from very small beginnings before the war, the organization employs over 500 people at factories at Dunstable and Welwyn Garden City. One immediate result of this deal is the acquiring of a factory at St. Helens, Lancashire, with a floor space of over 30,000 sq. ft. Reinforced plastics will be manufactured there to cater for the growing demand for these materials in the North of England and Scotland.

The company will continue operations as before; Mr. M. Lewin, technical director for 18 years, has retired, and the new board constitution is as follows: chairman, Mr. T. A. Fairclough, who is also chairman of Tootal Ltd., Mr. A. Reingand and Mr. N. Illingworth are joint managing directors, the latter also functioning as deputy chairman, Mrs. Y. Reingand remains on the board and two new additions are Mr. J. Morrish, company secretary, and Miss L. M. Barnett. Miss Barnett has been with the company for many years, and her appointment to the board will bring pleasure to her many friends in the industry.

Tootal Ltd. have a very fine record and are already interested in the manufacture of glass fabric. This fusion of interest with Thermo-Plastics Ltd., one of the most progressive of the fabricating groups in the plastics industry has every symptom of a highly successful alliance and I anticipate that the general growth of the Dunstable company, already fast, will be considerably accelerated.

* * *

A New Lotus Coupe. An outstanding feature of the National Motor Show at Earls Court this year was a brand new competition coupe, the " Elite," a two-seater with phenomenal acceleration and a top speed of 130 miles per hour. The " Elite," built by Lotus Engineering Ltd., has been designed by a team headed by the well-known engineer and racing driver, Colin Chapman, whose racing cars have met with such success in recent years. The coupe weighs only 10½ cwt., is 12 ft. long and less than 4 ft. high with a ground clearance of 6½ in. It has no chassis in the accepted sense; but the main assembly consists of a chassis-body-unit built up from polyester/glass mouldings. The principal components consist of a large front moulding, a combined roof and rear moulding and an under-tray. An unusual feature is the use of polyester/glass for the tunnel in which the main drive shaft is housed. Other polyester/glass components include the doors, bonnet cover and boot lid. The use of metal components has been reduced to a minimum: for example, wherever a bond is required between metal and metal or metal and plastics, epoxide resin adhesives have been used, thereby avoiding the need for riveting. The polyester and epoxide resins used in the construction of the Lotus " Elite " are supplied by Bakelite Ltd.

Would that all the resin-glass car bodies at the Motor Show had been so well designed and made. One vehicle embodied in its body structure a number of faults, and left much to be desired. With the examples set by Jensen and Lotus, there is now no excuse for the production of shoddy polyester glass bodies.

* * *

Professor A. Charlesby. It gives me great pleasure to record the appointment of Dr. A. Charlesby to the chair of physics at the Royal Military College of Science, at Shrivenham. During the war he worked with the Ministry of Aircraft Production, and later flew operationally with the R.A.F. whilst investigating bombing efficiency. Following the war, he joined the Atomic Energy project at Harwell where he was in charge of a research group studying the effects of radiation on materials, particularly metals. In 1955 he joined the new research laboratories of Tube Investments Ltd., at Hinxton Hall, building up a very successful radiation department. I wish him, in his new post, every success.

* * *

Ashdowns Ltd. Following the announcement by Pilkingtons that Ashdowns are to cease trading, arrangements have been made for a number of that company's products to be continued in manufacture by Mica & Micanite Supplies Ltd., of Barnsbury Square, London, N.1. The latter organization is now offering a complete range of laminated products based on glass fibre materials including silicone, melamine, phenolic, epoxy, and polyester resin bonded sheet, round and rectangular tube, moulded angles and rod. This means that the well-known grades of materials produced by Ashdowns under the trade name Ashlam, will continue to be available for the many known uses for which they have been developed over the past 10 years. As well as supplying materials in the various forms above, Mica & Micanite Supplies Ltd. are also offering a complete fabricating service in all these products. Prototype work can be carried out as well as bulk production.

* * *

Mr. Walter Swallow. As announced last month, Mr. J. W. Carr has resigned from B.I.P. Chemicals Ltd. Mr. Walter Swallow, a director of the company, has now been appointed works director to take charge of the departments formerly operated by Mr. Carr.

Mr. Walter Swallow

* * *

Borough Polytechnic Education Conference. On October 4 the Annual Conference of the Plastics Institute on Education was held at the Borough Polytechnic under the chairmanship of Dr. J. C. Swallow, president of the Plastics Institute. Lecturers in plastics technology at the various centres throughout the country discussed the examination results for 1957 and the regulations and syllabuses of the Institute. In the afternoon, Sir Miles Thomas, chairman of Monsanto Chemicals Ltd., addressed the gathering on " The Challenge of Plastics to the Arts and Technology." In the course of his speech he stressed the necessity for new thinking in the application of plastics materials both in industry and in the home, urging that new design concepts are needed to make the fullest use of the many new materials now at hand.

* * *

Pre-mix. Many readers have expressed interest in the article by Mr. A. Lessheim in the September issue of *Plastics* (pages 356–358) on " Progress with Pre-mix in North America." The tonnage consumption of these materials in the United States and Canada is indicative of the potential market these materials have and, as Mr. Lessheim suggests, great care will be needed to ensure that the development of these materials is governed by sound technological advice. Pre-mix manufacturers in North America are taking great care to advise customers on the correct methods to be used for manipulation and moulding and are fully alive to the difficulties that can arise if the materials fall into the hands of unskilled manipulators.

* * *

International Standards Organization. The meeting of I.S.O./TC61–plastics was held at Burgenstock, Switzerland, in July. The report on the proceedings, available from the British Standards Institute, 2 Park Street, London, W.1, has just been published. The British delegates were :—Mr. G. Dring (Leader), Dr. H. M. Glass, Mr. H. Warburton Hall,

The new Lotus shown at the recent Motor Show. Bakelite polyester and epoxy resins are used in its construction.

Mr. R. Hayes, Mr. A. A. Tomkins, Mr. C. Wainwright, Mr. P. Welford and Dr. A. H. Willbourn. In an unobtrusive way, the work carried out by the International Standards Organization is gradually bringing together the nations of the world towards uniformity on methods of tests, etc. Amongst the topics dealt with during the July meeting were: determination of bleeding of colorants from plastics, determination of thermal stability of p.v.c. and the determination of the melt flow index of polythene.

* * *

Facts and Figures on Plastics. The table below has just been issued by the Board of Trade. It indicates that total sales of plastics materials in the first half of 1957 amounted to 196,000 tons, nearly 19% higher than in the first six months of 1956. Exports were 8,000 tons higher than for the previous period accounting for 27% of total sales. Leading in this big expansion are polythene, polystyrene and p.v.c. Thermosetting materials also showed a 5% increase in sales over the first half of 1956.

It should be noted that returns from paint manufacturers who make plastics materials for incorporation in their products are included in the table whereas firms making cables who manufacture plastics materials from purchased resins are excluded. Synthetic materials for use as textiles are also excluded. Figures are also free of any duplication or double count of plastics materials at the different stages of manufacture.

NET SALES OF PLASTICS MATERIALS FOR THE YEARS 1954, 1955, 1956, AND FOR THE FIRST HALF OF 1957

('000 tons)

	1954 (whole year)	1955 (whole year)	1st Half 1956	2nd Half 1956	1st Half 1957
THERMOSETTING MATERIALS—					
1. **Alkyds :**					
Solid and liquid resins	29.6	28.1	15.6	15.1	17.5
Solutions, emulsions and dispersions (net resin content)	4.2	7.8	4.4	4.2	4.8
Other			0.2	0.2	0.2
Total	33.7	35.8	20.1	19.4	22.5
2. **Aminoplastics :**					
Solid and liquid resigns, including solutions (net resin content)	23.9	26.9	14.1	14.3	14.9
Moulding and extrusion compounds	19.1	20.0	10.7	9.8	10.8
Total	43.0	47.0	24.8	24.2	25.7
3. **Casein plastics :**					
Sheet, rod, tube and profile shapes	2.1	2.7	1.4	1.3	0.9
4. **Phenolics and cresylics :**					
Straight solid and liquid resins	12.8	12.5	6.5	4.9	5.4
Modified solid and liquid resins	5.3	6.0	3.0	2.7	3.1
Solutions, emulsions and dispersions (net resin content)	1.7	1.7	0.7	1.5	1.5
Moulding and extrusion compounds	27.6	31.2	13.3	12.6	13.0
Decorative laminated sheet	14.7	19.8	3.7*	4.0	4.0
Other laminated sheet			4.2*	4.2	4.7
Cast sheet, and laminated or cast rod, tube and profile shapes			1.7*	1.6	1.6
Total	62.1	71.2	33.1	31.5	33.3
5. **Polyesters**	0.4	0.9	1.0	1.2	1.4
6. **Other thermosetting materials**	1.9	2.5	1.7	1.7	2.4
Total thermosetting materials	143.1	160.0	82.1	79.3	86.2
THERMOPLASTIC MATERIALS—					
7. **Cellulose plastics :**					
Moulding and extrusion compounds	6.7	6.6	3.0	3.2	3.3
Other (including photographic film base)	4.5	5.3	2.6	2.6	2.9
Total	11.2	11.9	5.6	5.8	6.1
8. **Polyvinyl chloride :**					
Solutions, emulsions and dispersions (net resin content)	2.0	1.6	0.7	0.6	0.9
Moulding and extrusion compounds	26.6	27.8	13.5	13.3	16.5
Plasticized sheet	12.9	17.5	7.2	8.8	12.5
Unplasticized sheet			1.0	1.2	0.9
Rod, tube and profile shapes			0.6	0.3	1.2
Total	41.5	46.9	23.1	24.1	32.0
9. **Polystyrene :**					
Moulding and extrusion compounds	20.9	20.6	10.2	12.6	13.6
Other	0.5	0.7	0.4	0.5	1.0
Total	21.4	21.3	10.7	13.1	14.7
10. **Vinyl acetates**			6.0	5.0	6.9
11. **Other thermoplastic materials** (including acrylics, polyamides, polytetrafluorethylene, polythene and polyvinyl chloride resins (i.e. polymers sold as such))	55.6	76.4	37.5	45.4	50.2
Total thermoplastic materials	129.7	156.4	82.8	93.4	109.9
TOTAL ALL PLASTICS MATERIALS	272.9	316.5	164.9	172.7	196.0

* Partly estimated.

It should be noted that returns from paint manufacturers who make plastics materials for incorporation in their products are included in the table whereas firms making cables who manufacture plastics materials from purchased resins are excluded. Synthetic materials for use as textiles are also excluded. Figures are also free of any duplication or double count of plastics materials at the different stages of manufacture.

* * *

Nylon Slide Fastener. The other day I attended a press reception at the Westbury Hotel to launch the Optilon slide fastener which consists essentially of spirally wound nylon monofilaments. Among the plus points claimed for this new fastener are extreme flexibility, virtual invisibility when sown into a dress, a wide colour range and the fact that both spiral and tape are exactly matched for colour.

A charming model assisted Mr. G. Cansdale, the Television Zoo expert to fix an overcoat on to a live python to demonstrate the fastener's flexibility. I, and a hundred-odd other souls were more interested at that point in the flexibility of the python which, although "defanged," had a very nice line in dorsal muscles.

* * *

Conversazione. The Science Museum does not immediately conjure a vision of gaiety and fun. How wrong ! If you had been there on October 4, the scene would have astonished you. First the museum itself, a lovely building, far removed from the dingy atmosphere one expects to find. Then the exhibits, obviously lovingly attended, designed to be looked at and not roped off from the *hoi polloi*. And the staff, courteous, proud of their charge, anxious that you should enjoy your visit, welcoming an influx of people long after normal hours. And the Plastics Institute members, discovering with obvious pleasure that of the many places in London in which a party can be held, the Science Museum comes very near the top in attraction.

To receive the members and their guests (far too few at 280), were Dr. and Mrs. Swallow. His presidency has begun well, in an atmosphere fully in keeping with that of a professional body, and some will have been astonished to find that an academic *soirée* can also be enormous fun. The orchestra of the Royal Horse Guards had heard all about "Damn Yankees," to say nothing of mambo, calypso and plain good tempo dance music. The buffet was excellent in quality though short in quantity.

A small sub-committee of Council members organized this function, procuring the films for the film show, arranging the buffet, negotiating for the orchestra, and looking after many other smaller items as well. They deserve our thanks, these few who worked behind the scenes, for arranging a function that was entirely in keeping with a professional body, and that was at the same time tremendously good value for money.

PLASTIKON.

Book Reviews

Polythene.

Edited by A. Renfrew & Phillip Morgan. 576 *pages.*
Published by Associated Iliffe Press Ltd. Price 126*s.*

The publication of this volume was preceded by only a few weeks by the Interscience volume compiled by Raff and Allison. The reader now has the opportunity of examining two works, one American and one British, dealing with the same subject, polythene. Since polythene was primarily a British development the comparison in many respects is interesting.

The structure of the book differs radically from its American counterpart in that it is essentially a compilation of contributions by specialists in various fields, hence losing the continuity which Raff and Allison so admirably obtained. On the other hand, the contributors themselves represent the highest level of achievement in their respective fields both in this country and America and a more balanced appraisal of each individual aspect of the subject is probably given in the British volume. Rather more emphasis is given to practical technology and applications than is the case by Raff and Allison and a true comparison would probably be to say that the British volume has a bias towards the technological, whereas its American counterpart is biased towards the scientific. In this sense, and probably accidentally, the books are found to be complementary rather than competitive although much of the content in one is duplicated in the other.

The Story of Expanded Rubber.

By A Cooper. 76 *pages.*
Published by Expanded Rubber Co., Ltd.

The Expanded Rubber Co., Ltd., has just come of age and to mark the occasion the history of expanded rubber has been compiled by Mr. A. Cooper, a director of the Company.

Primarily a domestic review of the development of one organization, this small book nevertheless contains a scholarly account of the early work in the field of expanded rubbers. Many early photographs have been reprinted, and the work as a whole provides a valuable addition to the technical literature in this important branch of technology.

The development of the Expanded Rubber Co., Ltd., as a large and flourishing organization is described in some detail, together with some valuable photographs of typical applications of the company's products. Copies of this book are available from Expanded Rubber Co., Ltd., Mitcham Road, Croydon, Surrey.

Moulage Par Injection, Volume 1

By Andre Cretin. 191 *pages.*
Published by "Industrie Des Plastiques Modernes."

Some readers of this review may, at some point in their studies, have encountered the typical French school book (in which language this present volume is written) dealing with elementary mechanics, heat, light and sound, etc. This book is in accordance with that tradition, not in the sense that it is elementary, but rather that it embodies the essentially practical approach which has come to be a feature of a French book intended for teaching purposes. This book contains very few photographs but a multitude of line drawings dealing with all aspects of injection moulding, from the toggle mechanism of the machine to the design of moulds. For any one who has an elementary grasp of French, this book will provide interesting reading for in its small compass it contains information that is very difficult to obtain elsewhere.

Glass Reinforced Plastics.

By Phillip Morgan. 276 *pages.*
Published by Associated Iliffe Press Ltd. Price 45*s.*

In his capacity as editor of our contemporary, *British Plastics*, the editor of this volume has had the valuable opportunity of consulting many technicians in the plastics industry experienced in reinforced plastics. The list of contributors is sufficient indication of authority and any person proposing either to use or manufacture glass reinforced products would be well advised to read this volume.

It should be said at once that the bibliographical references given are admirably detailed and that the only major flaw in the work lies in the restriction of its coverage to glass as a reinforcing medium. It is accepted that glass is the *major* reinforcement employed but it would have been helpful had a chapter been included which set out to analyse the properties of other reinforcements and to offer some critical comparison of them with glass in its various forms.

The examination of catalysts and accelerator mechanisms in the revised volume is still too sketchy to justify classifying this book under a scientific rather than technological heading. That more full information has been added on this aspect is, however, a welcome feature.

The book is excellently illustrated with both line drawings and photographs and it is in the fabricating and application fields that it truly excels.

Quality Control for Plastics Engineers.

By Lawrence M. Debing. 142 *pages.*
Published by Reinhold Publishing Corporation, (Chapman & Hall, London.) Price 40*s.*

This book has been sponsored by the Society of Plastics Engineers of America and has been written, as it says on the dust jacket, to help the plastics industry achieve the highest standards of performance. The records of the SPE quality control committee has been available to the editor, representing such companies as Hoover, Monsanto, Bakelite and the Erie Resistor Corporation.

The starting point for this book is the principle that quality control should be primarily a matter of studying processes rather than studying the products, sorting the good from the bad. The author's theme has developed from that premise and it may be said that for the first time a mathematical approach has been introduced. Equally, a strongly practical element is present which will enable the layman to understand at least the objects of the methods outlined even if not necessarily the methods by which they are performed. This should be recommended reading for all students of plastics technology and should go a long way towards not only improving the quality of plastics products but also reducing unnecessary and costly waste in manufacture.

Plastics Industrial Applications.

Published by Cascelloid.

This booklet is issued by Cascelloid Ltd., a division of the British Xylonite Co., Ltd., and shows the application of plastics in all branches of industry and commerce. It has been segregated under such headings as flexible bottles, protective clothing, glass reinforced mouldings, polythene bags, etc. It is exceedingly well produced and makes use of a very large number of photographs and apart from constituting an admirable advertisement for its publishers it will be found of the greatest interest by the layman who desires to have a pictorial record of the many ways in which plastics materials can be employed.

Man and Automation.

By L. Landon Goodman. 286 *pages.*
Published by Penguin Books. Price 3*s.* 6*d.*

This work is largely a philosophical examination of the problems rather than the techniques of automation. It is the latter with which *Plastics* has been predominantly concerned since the publication of an automation issue in September, 1956.

Automation in the plastics industry is not, of course, new and it has been rightly suggested, we think, that the plastics industry constituted the forerunner of an automated industry as we are beginning to understand the term. In recent years the word automation has come to assume a slightly unpleasant connotation, carrying in the minds of many an implication of redundancy and consequential labour problems. In short, there is a clash of interests between efficient production and levels of employment.

Mr. Goodman has set out to examine the problems raised by the introduction of automatic control, mechanical handling, etc., and in a remarkably interesting manner reviews the contributions that have been made by automation equipment, commencing with the installation of grain conveyors in the London Docks in 1890. In part two of his volume, he deals with the social, economic and other aspects of automation and it is here that his wide experience both in industry and commerce has been brought to bear with such great success. He refutes many of the bogies and offers convincing proof that automation, far from constituting a menace to our society, offers in fact concrete evidence for better living conditions for all. The scientist, the technologist and the industrialist should read this volume carefully.

Laboratory Glass-Working for Scientists.

By A. J. B. Robertson, D. J. Fabian, A. J. Crocker and J. Dewing. 184 *pages.*
Published by Butterworth Scientific Publications. Price 22*s.* 6*d.*

This is a fascinating work compiled by four highly qualified scientists with the object of explaining in simple terms the technology of working glass. It is a practical manual designed for the practical laboratory worker, who wishes to expedite his research by preparing some of his own apparatus in glass.

Machines for the Industry

The Baker Perkins 15/20 Extruder

The 15/20 Extruder has been developed for laboratory as well as production work and has many features which are of particular interest.

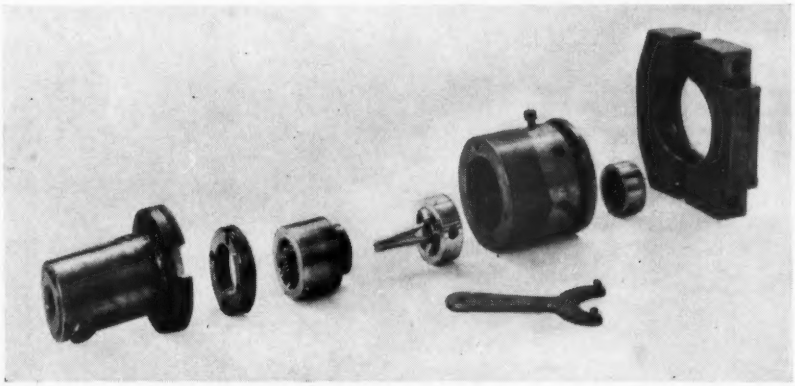
THE British Plastics Exhibition was notable, amongst other things, for the introduction of new and improved fabricating machinery resulting in a higher standard of finished product. One company who introduced new machinery at the Exhibition was Baker Perkins Limited, who created considerable interest by the first public showing of their new extruders. These machines have been designed by Baker Perkins and incorporate all the most modern advances in extrusion technology, together with several innovations which will appeal both to the technologist and to the operator.

The Model 15/20, which has been taken as the subject of this article, is the smallest of the range of extruders to be produced and has been primarily designed for the laboratory investigation of extrusion problems. This does not by any means preclude it from normal extrusion work and the design is such that it can, without any modification, be used for continuous production when outputs of over 50 lb. per hour are reported. In addition, the construction of the extruder provides adequate driving power for higher production rates when the machine is fitted with a 2 in. diameter screw and barrel in place of the 1½ in. version.

The use of an extruder for laboratory work demands special features and a considerable amount of flexibility in design. In these respects, the Model 15/20 can justifiably claim to meet the majority of the requirements. The 12½ h.p. motor provides ample power for working the extruder even under the most arduous conditions, while temperature control of the barrel is greatly improved by the specification of an induction heating system together with zoned water cooling. The screw speed is infinitely variable over different speed ranges, and the thrust on the screw can be measured under all conditions by the provision of a Statimeter. Finally, the sectionalized barrel construction provides a means of varying the length/diameter ratio from 10 : 1 to 20 : 1 and affords a means of introducing a vented section for the removal of volatiles.

Barrel Construction

As mentioned previously the barrel is of sectional construction having a permanent section (9) and two detachable sections (2) enabling screws having L/D ratios of 10:1, 15:1 and 20:1 to be used. The sections are turned from high quality steel and have water cooling channels machined into them, each section being a separate circulating zone. The channels are sealed by shrinking and welding a steel tube over them. At the end of each section an angled face is machined as the bearing surface for the barrel clamp (6). The barrel is lined with a Nitralloy liner, which is recessed at one end of each section to form an identical location for either the successive barrel section or the breaker plate (1) and die assembly. The butting faces of the liner are carefully ground so that when assembled there is no impedence to the flow of material within the barrel. The force exerted by the angled bearing surfaces of the clamps is taken on the liner to ensure accurate mating of the faces when under pressure.



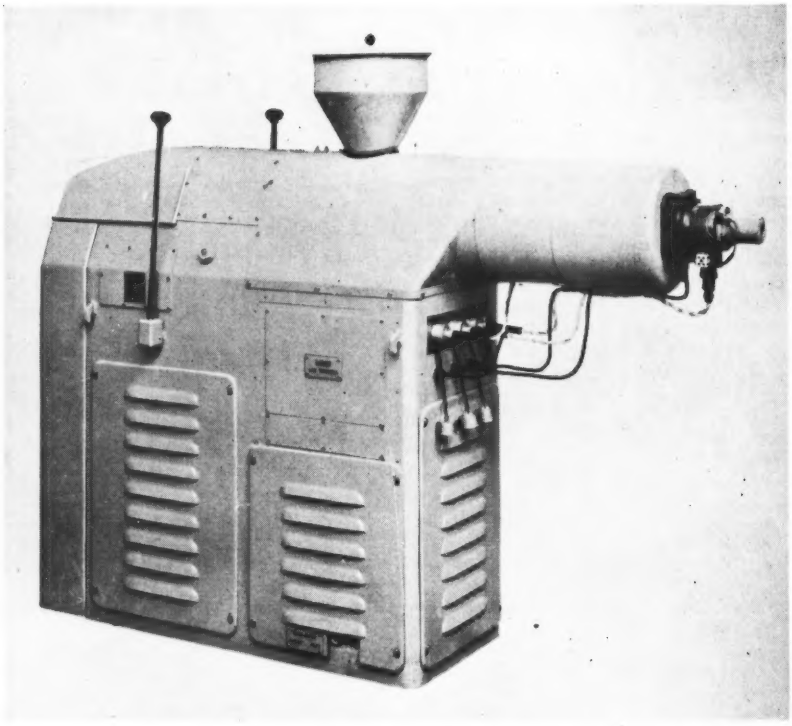
Tubing die for the 15/20 extruder showing the component parts as well as the breaker plate and clamp.

Extruder Screw

The extruder screw (8) is manufactured to suit individual requirements, different types being advocated for different materials. In all cases, however, the screw is of constant pitch, variable depth type and constructed from Nitralloy or stainless steel. Four splines connect the screw to the driving shaft and an extension bar passes through the shaft to form the connection for water cooling. The screw can easily be removed from the front of the machine after disconnecting the water cooling rotary union (16).

Heating and Cooling

The full length barrel is provided with four separately controlled heating zones, each of two kilowatt capacity. The heaters are of the induction type manufactured by Wild-Barfield



The right-hand side of the extruder showing water connection.

& Co., Ltd., and offer several advantages in use. In particular, rapid heating and accurate control are two features. This type of heating was fully described in *Plastics*, July and August, 1956. Connections for the detachable barrel sections, the head and the die are made at the front of the machine (31) as also are the thermocouples for these zones. The thermocouple pockets on the barrel are conveniently located and have adjustable depths.

The four heating zones on the barrel have their respective cooling controls (23). Water circulation is from the inlet pipe (29) via the manual controls to the cooling channels. Each section is self-contained, water entering, in the case of the detached section (2), through (3), circulating around the barrel section and by a reverse spiral channel returning to (4). By this means a uniform cooling of the barrel is obtained, minimising the effects of cold spots where the cooling water enters. From (4) water is returned to the tundish (33) where the circulation can be observed and thus controlled through the transparent cover (24) and the temperature measured if required. From the tundish the water drains to the outlet pipe (30).

The hopper section of the barrel is permanently cooled and control of the cooling water for the screw is effected by the valve (17).

Drive and Lubrication

Power for the Model 15/20 is supplied by a 12½ h.p., 3,000 r.p.m. constant speed electric motor (28) flange mounted to a mechanical infinitely variable speed unit (27) which is manually adjusted by means of a hand wheel (26) through over a range of approximately 5:1. A vee-belt drive (25) transfers the power to the main reduction gearing; the two vee-belt pulleys being secured to their respective shafts by Fenner taper lock bushes can thus be simply replaced to obtain different speed ranges. An adjustable jockey pulley is fitted to maintain the belt tension at all times.

The main reduction gearing is by a specially designed bevel reduction helical gear train. On the layshaft of the gear train is a Taylor Patent multi-disc friction clutch (19) operated by the levers (20) and at the end of the same shaft is the sprocket and chain drive (32) for the tachometer. The drive is transmitted to a screw through the thrust meter element (13) and thrust bearing (12). This latter item is a normal ball bearing type of adequate capacity and is located on journal races (11).

The normal screw speed range is from 16 to 80 r.p.m. and the drive is capable of transmitting from 4½ h.p. at 16 r.p.m. to 12½ h.p. at 80 r.p.m.

Positive lubrication of the gear train is by a circulating splash system and of the thrust bearing assembly by grease points (14).

As safety precautions and protection for the screw, a shear pin is fitted in the final drive and in addition the clutch can be adjusted to slip at a pre-determined torque. The motor is also fitted with a cut-out.

All driving shafts are supported on ball bearings, housed in the main frame of the extruder which is fabricated from steel plate. A cover (18) encloses the vee belt drive giving access for the changing of pulleys, and louvred side panels enable inspection of the motor to be made. The barrel is fitted with detachable steel covers.

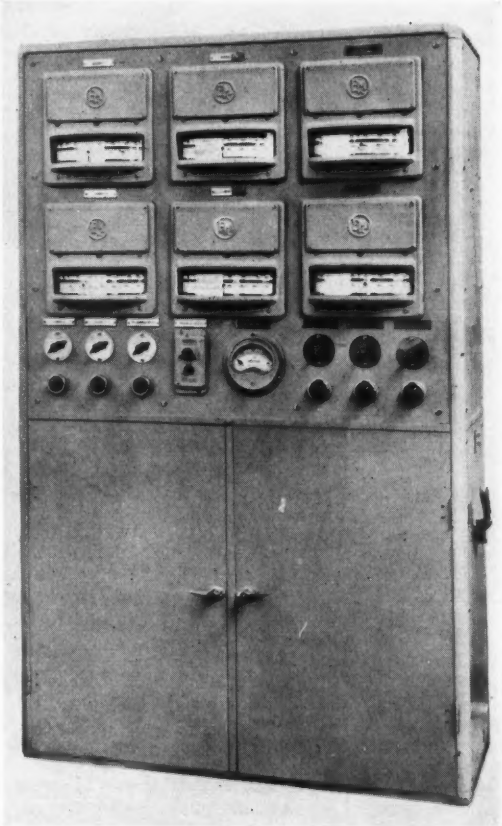
The extruder illustrated is fitted with a normal gravity feed hopper manufactured from stainless steel. This can, however, be easily substituted by a vibrating hopper or force feed mechanism according to the requirements of the compound being extruded.

Instruments and Controls

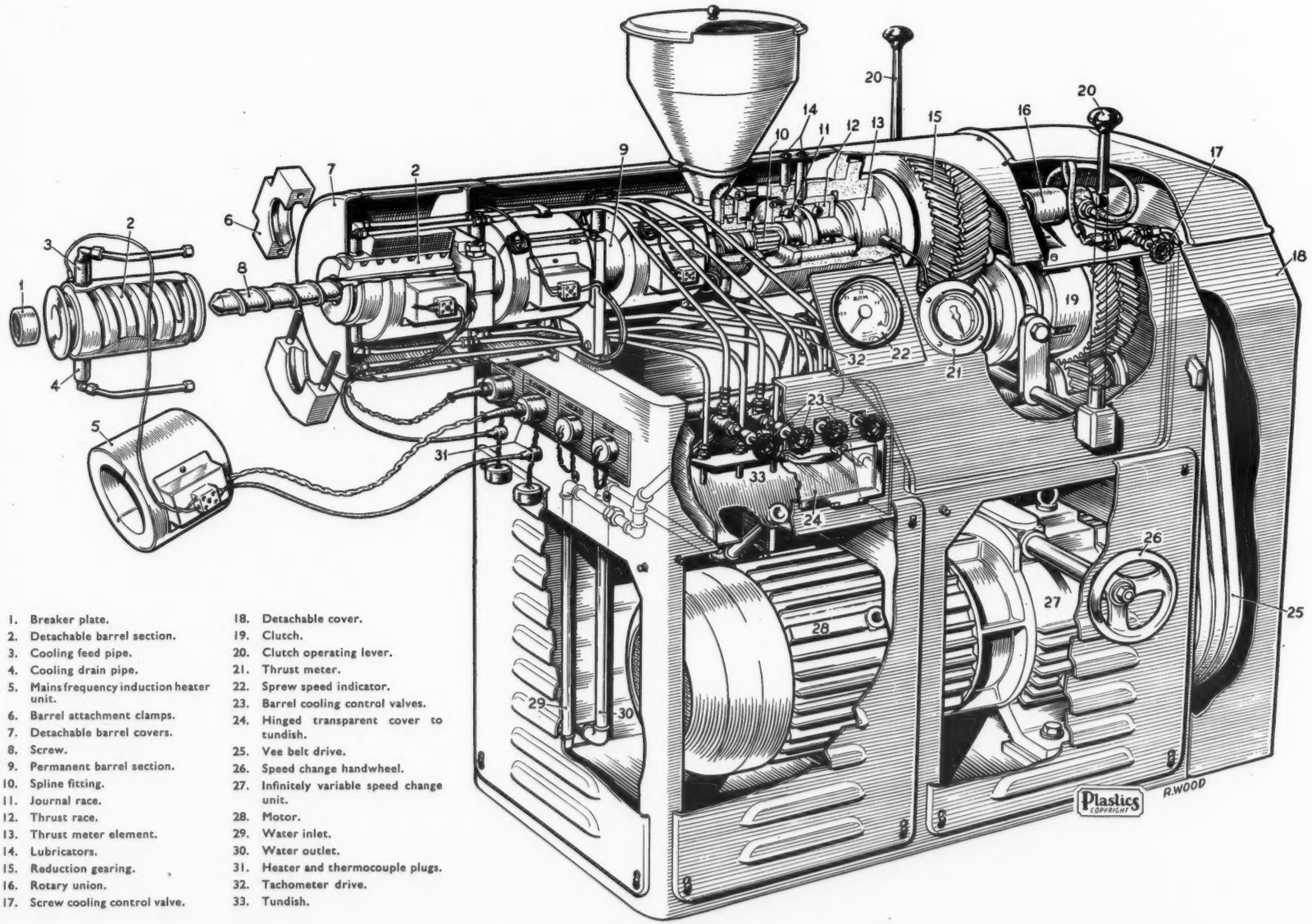
The control panel is a separate unit, housing six proportional type temperature controllers, motor starter gear, ammeter, fuses, relays and indicator lamps. The screw speed indicator (22) and the Statimeter thrust indicator (21), calibrated from 0 to 20,000 lb., are both located on the extruder main frame. Manual controls for cooling and speed regulation have been mentioned in previous paragraphs.

Heads and Dies

Standard heads and dies for tube manufacture, wire covering, etc., are available for this extruder and Baker Perkins Ltd. will undertake the manufacture of special dies to customers' specifications. All heads are attached to the barrel by the same clamps as are used for joining the barrel sections thus enabling a die to be fitted to any length of barrel.



The separate control panel showing temperature controllers and switchgear.



1. Breaker plate.
2. Detachable barrel section.
3. Cooling feed pipe.
4. Cooling drain pipe.
5. Mains frequency induction heater unit.
6. Barrel attachment clamps.
7. Detachable barrel covers.
8. Screw.
9. Permanent barrel section.
10. Spline fitting.
11. Journal race.
12. Thrust race.
13. Thrust meter element.
14. Lubricators.
15. Reduction gearing.
16. Rotary union.
17. Screw cooling control valve.
18. Detachable cover.
19. Clutch.
20. Clutch operating lever.
21. Thrust meter.
22. Sprew speed indicator.
23. Barrel cooling control valves.
24. Hinged transparent cover to tundish.
25. Vee belt drive.
26. Speed change handwheel.
27. Infinitely variable speed change unit.
28. Motor.
29. Water inlet.
30. Water outlet.
31. Heater and thermocouple plugs.
32. Tachometer drive.
33. Tundish.

Graft Copolymers—Part I

By S. H. PINNER,* Ph.D., F.R.I.C. and V. WYCHERLEY,* B.Sc.

In this, the first of a series of articles, the authors discuss nomenclature and chemical methods of preparation

THE simplest type of macromolecule is that which has an essentially linear structure and is composed of only one type of monomeric repeat unit. By polymerizing a mixture consisting of two or more types of monomer, it is possible to synthesize a wide variety of copolymers and achieve a considerable range of chemical and mechanical properties. In such copolymers, the monomer units are distributed at random, the relative abundance and sequence length of the units along the chain being governed by the reactivities of the monomers concerned and by their relative concentration in the polymerizing mixture.

In a random copolymer, the sequences are generally short in accordance with the laws of probability, and it appears to be impossible, by this technique, to produce copolymers consisting of long sequences of *both* monomer types. Non-random copolymers can, however, be made by special techniques and are assuming increasing importance both from academic and commercial standpoints (1). These materials have been variously described as " block " and " graft " copolymers, occasionally in such a way as to cause ambiguity and it may be worth giving some thought to the question of nomenclature.

Nomenclature

In the Report on Nomenclature in the field of macromolecules by the International Union of Pure and Applied Chemistry (2), graft copolymers are defined in the following words:

" A graft copolymer is a high polymer, the molecules of which consist of two or more polymeric parts of different composition, chemically united together. A graft copolymer may be produced, for example, by polymerizing a given kind of monomer with subsequent polymerization of another kind of monomer on to the product of the first polymerization. The union of two different polymers by chemical reaction between the molecular end groups or by a reaction producing crosslinks between the different materials would also produce a graft copolymer."

This definition takes in various kinds of non-random copolymers and it is significant that " block " copolymers are not mentioned in this report. Later work has produced the need to classify these non-random copolymers more closely. Allen and other workers (3) for example, define the terms as follows:

" The term ' block ' copolymer is not standard. We use it to describe linear molecules whereas branched structures arising from the attachment of side chains of one type of monomer unit on to a backbone of the other types, we call graft copolymers."

This distinction between graft and block copolymers is illustrated structurally in Fig. 1. Whereas this method of representing the structure is adequate for many non-random copolymers, difficulties may arise when crosslinking occurs. As will be seen below, the commonest method of synthesizing a graft copolymer is to form an initiating site on an existing polymeric chain and to allow a new chain to grow from this site. The growing chain will terminate by chain transfer, disproportionation or coupling. In the first two cases, the structure shown in Fig. 1b will result. When the branches terminate by coupling, however, they may serve to link two or more polymeric backbones together to give the structure shown in Fig. 2.

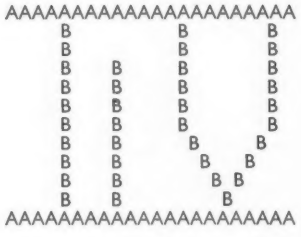


Fig. 2.

This may be regarded with equal propriety as a graft copolymer bridged by B units or a block copolymer of A and B bridged by A units. Additional complications arise when a normal copolymer is used as the grafting substrate and when the added branches comprise one of the monomers (Fig. 3a) and also when the initial polymer is already highly branched (Fig. 3b).

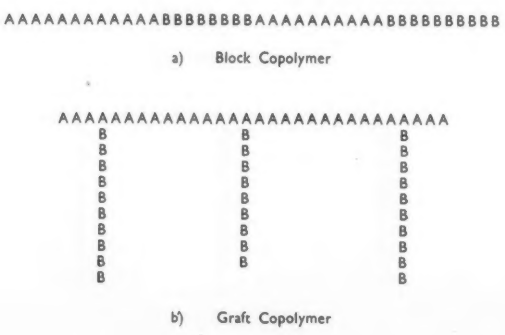
The chief objection to any discrimination between normal, block and graft copolymers on the basis of structure alone is that the fine structure is very frequently unknown. It is nonsensical to speak of investigating the structure of a graft copolymer, when the title already specifies the structure.

These difficulties would be resolved if copolymers could be classified in terms of origin rather than structure. One would say that random copolymers are made from a mixture of two monomers, block copolymers from a mixture of two polymers and graft copolymers from a polymer and a monomer. To cater for simultaneous crosslinking or bridging, the materials could be called infusible or network graft (or block) copolymers. (This description in terms of origin rather than structure has precedent in the use of the terms " addition " and " condensation " polymers, which despite obvious failings, are nevertheless universally retained as the main classification of thermoplastics.) If such a classification was accepted, it would be possible to extend the nomenclature recommendations of the International Union of Pure and Applied Chemistry (2) to cover non-random copolymers. The chief features of the proposed scheme are the use of letters " b " and " g " to signify block and graft copolymers, an oblique stroke to indicate a physical mixture and a numerical designation following the name to indicate the composition where known. In this numerical designation weight fractions or mole fractions could be used. The use of weight fractions seems more appropriate on the whole, but either form could be utilized, provided that the numerals were followed by the letters " w " or " m " to indicate weight fractions or mole fractions. The scheme is clearly illustrated by the examples given in Tables 1 and 2.

Chemical Methods of Synthesis of Non-random Copolymers

An excellent review of chemical methods of synthesis of graft copolymers has been given recently by Gaylord (4) and only a selection of the more significant methods are outlined in the following account.

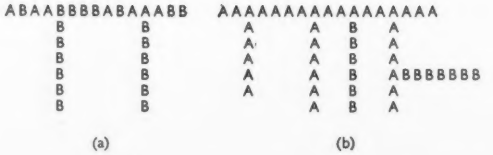
The well-known process of chain transfer in vinyl polymerization is considered to be responsible for the formation of branched homopolymers. A primary or growing free radical may become inactivated or terminated by abstracting a hydrogen atom from a polymer molecule, thereby creating a free radical on the polymer chain. Monomer molecules may add to this free radical which thus constitutes a site for the growth of branches (see Fig. 4).



a) Block Copolymer

b) Graft Copolymer

(Left) Fig. 1a and 1b, showing distinction between graft and block copolymers.
(Right) Fig. 3a and 3b.



(a) (b)

* T.I. Research Laboratories.

TABLE 1

SUGGESTED NOMENCLATURE FOR GRAFT AND BLOCK COPOLYMERS

NAME	MEANING
Polythene	Homopolymer of ethylene
Polyethylene/acrylonitrile	Mixture of ethylene homopolymer with acrylonitrile monomer
Polyethylene/polyacrylonitrile	Mixture of the homopolymers
Poly (ethylene-co-acrylonitrile)	Normal or random copolymer of ethylene and acrylonitrile
Poly (ethylene-g-acrylonitrile)	Graft copolymer of ethylene and acrylonitrile in which acrylonitrile has been grafted to polyethylene
Poly (acrylonitrile-g-ethylene)	Graft copolymer of ethylene and acrylonitrile in which ethylene has been grafted to polyacrylonitrile
Poly (ethylene-b-acrylonitrile)	Block copolymer of ethylene and acrylonitrile made from a mixture of polyethylene and polyacrylonitrile
Poly (vinyl chloride-co-acetate-b-ethylene)	Block copolymer made from a vinyl chloride/vinyl acetate copolymer and polyethylene
Cellulose acetate-g-polyacrylonitrile	Graft copolymer made from cellulose acetate and acrylonitrile
Cellulose acetate-co-butyrate-b-poly(vinyl chloride-co-acetate)	Block copolymer made from cellulose acetobutyrate and a vinyl chloride/vinyl acetate copolymer

This provides one of the most important routes to graft copolymerization for it is only necessary for the monomer present to be chemically dissimilar from the polymer for the product to be not a branched homopolymer but a graft copolymer. The possibility of a reaction between a monomer and a dead polymer chain has been confirmed by radioactive tracer techniques, whereby styrene labelled with radioactive Carbon-14 has been polymerized in the presence of inactive polystyrene, to give rise to a product containing branches derived from the active monomer (5). The chief objection to this method from a practical standpoint is that the monomer not only forms branches but also unattached homopolymer, which may be difficult to remove.

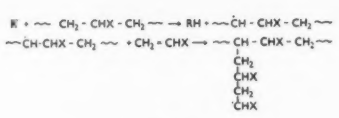


Fig. 4.

To overcome this, modifications are necessary to thwart homopolymerization. As an example, monomer and catalyst may be added to a polymer latex. It is known that polymerization in emulsion only occurs in the swollen polymer latex particles and not in the monomer droplets. Homopolymerization cannot occur since this would require the formation of new latex particles and this in turn requires the addition of soap or similar emulsifier. The addition of soap is therefore highly critical and determines whether essentially graft copolymer will be formed or whether this will be contaminated with homopolymer. This method has been employed to produce Heveaplus, a rubber-g-poly (methyl methacrylate) as dealt with below. Similar protection from homopolymer formation can also be obtained by special irradiation techniques which will be described more fully in part II of this paper.

A good way of avoiding homopolymer formation is to dispense with the conventional catalyst and to produce free radical sites on the polymer chain by thermal or photolytic activation of suitable substituents. Hydroperoxide groups have been formed by copolymerizing styrene with a small amount of p-isopropyl styrene and partially oxidizing the product which can then be used as a macromolecular initiator for the thermal or ferrous ion-activated emulsion polymerization of methyl methacrylate (5) (Fig. 5).

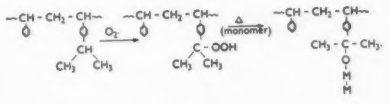


Fig. 5.

Per-ester groups have been introduced into poly (methyl methacrylate) by treating the polymer with phosphorous pentachloride followed by tert-butyl hydroperoxide (7). The resulting structure can initiate the grafting of styrene, vinyl acetate and acrylonitrile to the poly (methyl methacrylate) backbone (Fig. 6). More directly, poly (acrylyl chloride) has been treated with tert-butyl hydroxide to form per-ester groups, or with perbenzoic acid to form peroxide groups (4) attached to the chain. Both types have been used to initiate the polymerization of methyl methacrylate (Fig. 7).

Branched polystyrene has been synthesized by brominating polystyrene photochemically, dissolving the brominated polymer in styrene monomer and then irradiating the solution with ultra violet light of such a wavelength that the bromine atoms are removed, leaving polymer radicals which can initiate polymerization (8).

A method for preparing a branched non-random copolymer by the interaction of two polymers has been described recently. Polystyrene, containing a terminal amine group was prepared by initiating the polymerization of styrene with sodium amide in liquid ammonia at —33° C. The amine groups of the polystyrene were then reacted with the pendant isocyanate groups of a polymer prepared by copolymerizing butyl methacrylate with a small amount of β isocyanatoethyl methacrylate (9) (Fig. 8). Even at the low concentrations of the amine and isocyanate groups present high conversions of a grafted polymer were obtained. The method permits the synthesis of copolymers with well defined molecular weights and numbers of side chains.

The susceptibility of various monomers and polymers towards grafting will depend on the methods of synthesis employed and the reactivities of the radicals involved. A study of the efficiency of the grafting process, using an emulsion polymerization technique placed vinyl chloride, vinyl acetate and styrene in decreasing order of activity while polymers decreased in susceptibility to graft copolymerization in the order poly (vinyl chloride), polyacrylonitrile, poly (vinyl acetate) and polystyrene (10).

An interesting series of graft copolymers is based on the ability of an ethylene oxide ring to be opened by the active hydrogen of a hydroxyl or amide group. By copolymerizing styrene with a small amount of vinyl acetate and then hydrolysing the acetate groups a polystyrene backbone having widely separated

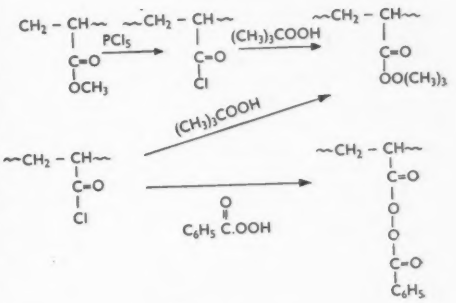


Fig. 6 (top) and 7.

TABLE 2

SUGGESTED NOMENCLATURE FOR GRAFT AND BLOCK COPOLYMERS

NAME	MEANING
Poly (ethylene-g-acrylonitrile) 70-g-30w	Graft copolymer made by grafting acrylonitrile monomer to polyethylene in which the per cent. weight fraction of acrylonitrile units is 30
Vinylite VYNS-b-nylon 66, 50-b-50w or, more fully Poly(vinyl chloride-co-acetate)-b-poly (hexamethylene adipamide) (90-co-10m) 50-b-50w	Block copolymer made from Vinylite VYNS and nylon 66 with equal weights of each and signifying that the molar composition of the Vinylite is 90% vinyl chloride and 10% vinyl acetate
Poly(ethylene-g-methyl methacrylate)/poly (ethylene-co-methyl methacrylate) 30-g-40w/3-co-27w	A sample of polyethylene initially weighing 30 gms which showed a weight gain after grafting of 70 gms of which 30 gms could be solvent extracted and analysed as 10 weight per cent. ethylene and 90 weight per cent. methyl methacrylate units (This type of sample arises in radiation grafting)

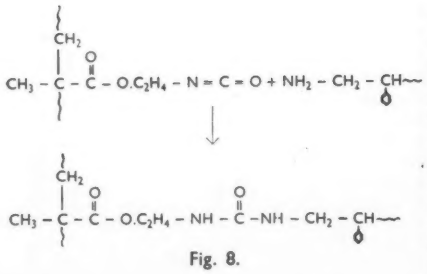


Fig. 8.

hydroxyl groups can be prepared. These can initiate a polyaddition reaction with ethylene oxide (Fig. 9). No homopolymer from the oxide will be formed.

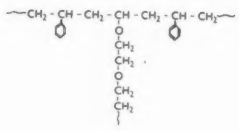


Fig. 9.

In an analogous manner ethylene oxide has been grafted to polymer containing amide groups to produce poly (ethylene oxide) branches (11).

Many of the methods utilized in the syntheses of graft copolymers involve free radical mechanisms. Attempts made to prepare a series of graft copolymers based on polystyrene derivatives via an ionic chain transfer mechanism succeeded only in the case of styrene and poly (p-methoxy styrene) (12).

Graft Copolymers from Rubber

There is no reason, in principle, why both components of a graft copolymer should be synthetic in origin, and a considerable amount of effort has been devoted to preparing graft copolymers based on rubber. Some formulations of this type are available commercially under the trade name " Heveaplus." (13).

Although investigations began some 20 years ago with a view to modifying rubber by polymerizing monomers dispersed in latex, it is only comparatively recently that the nature of the combinations produced have been elucidated (14). The method employed to prepare graft copolymers of rubber and vinyl monomers is to polymerize the monomer in the presence of the rubber (which may be in dry form, in latex or in solution) using a suitable free radical initiator. Several vinyl monomers have been investigated but styrene and methyl methacrylate have received the greatest attention and are considered more likely to lead to products finding technical applications.

A study of the polymerization of methyl methacrylate and styrene in the presence of rubber in benzene solution has been carried out using benzoyl peroxide and azobisisobutyronitrile as catalysts (15). When initiated by peroxide the product consisted of a mixture of unchanged rubber, free homopolymer and graft copolymer. The components were separated by fractional precipitation with suitable solvents. The importance of selecting a suitable catalyst is evidenced by the fact that, in the case of azobisisobutyronitrile, no graft copolymer was formed. This is inconsistent with any suggestion that the mechanism involved is a simple transfer process between the growing polymer and the rubber. It has been suggested that radicals produced by the decomposition of the peroxide can directly abstract hydrogen atoms from the rubber, leaving polyisopropenyl radicals which can initiate polymerization of the monomer (16). The failure of azobisisobutyronitrile to do this would be in keeping with the fact that, unlike benzoyl peroxide, it cannot induce crosslinks in rubber. The grafted side chains, in the case of a poly(methyl methacrylate) rubber graft have been detached by subjecting the copolymer to ozonolysis which quantitatively destroys the rubber and leaves the side chains unaffected (17). Their molecular weight proved to be the same as that of the free homopolymer formed in the reaction.

For large scale preparations, polymerizations in rubber latex are preferred, and although natural latex usually retards the polymerization of vinyl monomers several catalytic systems are known to be effective in initiating the reaction. Polyamine activated hydroperoxides are favoured as initiators for the preparations of graft copolymers from styrene or methyl methacrylate, and lead to high yields without the necessity of de-ammoniating or de-aerating the latex. To obtain the maximum interaction between the rubber and the monomer, conditions must be such that the polymerization occurs within the latex particles and not in emulsified monomer particles. Although this is not difficult to achieve with hydrophobic monomers, more difficulty is experienced with those which are water-soluble.

Other monomers which have been successfully grafted to rubber include ethyl acrylate, acrylonitrile and vinylidene chloride. Attempts to graft vinyl acetate have been unsuccessful. Experiments with this monomer in conjunction with the model compound dihydromyrcene (di-isoprene) have indicated that allyl radicals are insufficiently reactive towards the monomer to result in appreciable rates of grafting (18).

When rubber is masticated on a mill the shear applied can rupture the molecules and give rise to fragments terminating in free radicals. In the absence of oxygen (or any other " radical acceptor ") these fragments will recombine. However, if the mastication is carried out in the presence of a vinyl monomer the radicals produced may initiate its polymerization (19) (Fig. 10).

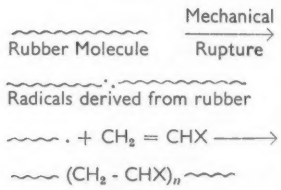


Fig. 10.

The simple scheme shown in Fig. 5 would give rise to linear copolymers. Alternatively, a radical may be terminated by abstracting a hydrogen atom from another rubber molecule. In this case, the free radical produced on the main chain can initiate the polymerization of a monomer and form a branched copolymer (Fig. 11).

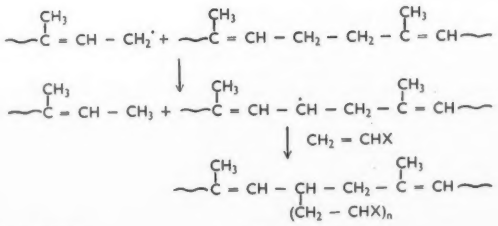


Fig. 11.

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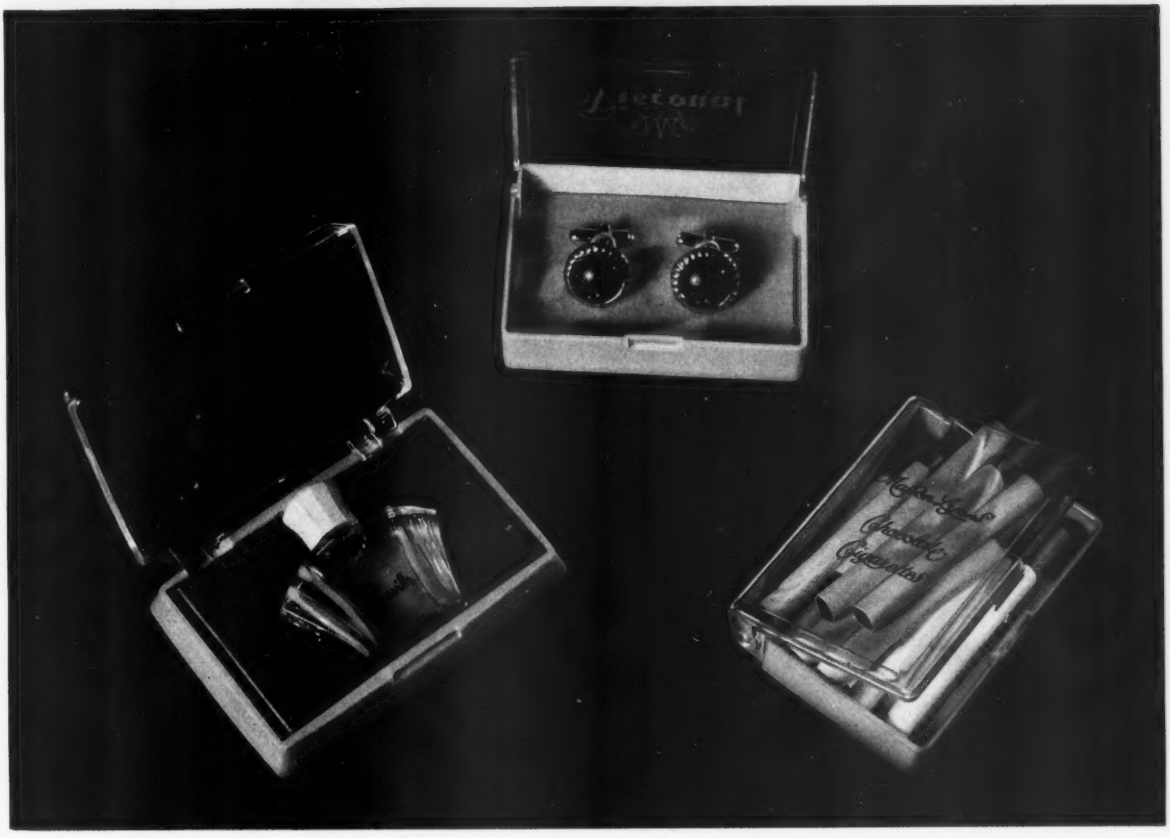

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Improved Welding Technique for Thermoplastic Materials

By HEINRICH SCHULZ,* Dipl. Ing.

THERMOPLASTIC MATERIALS, in particular rigid polyvinyl chloride, are being used on an ever increasing scale for the manufacture of chemical plant.

This material is eminently suitable for the purpose on account of its chemical resistance and the ease with which it can be formed into all kinds of shapes. It can also be welded and this fact has contributed considerably towards its increasing use in the chemical industry.

Welding plays an important role in the fabrication of chemical plant and apart from other welding processes such as heated tool welding, friction welding and high frequency welding, which are used only on a comparatively small scale, welding of rigid p.v.c. by the manual hot gas process can be almost called the classical method of fabrication.

Until quite recently it was the considered opinion of experts that satisfactory welds in p.v.c. could only be made by this manual welding process. Although the physical properties of the welds are satisfactory, the economics of hand welding are far from acceptable.

The search for a more economic welding process which was carried out in Germany by Aug. Schnakenberg and Co., has resulted in the design of new types of semi-automatic and fully automatic welding machines for this purpose.†

Details are given below of the new welding process which has been developed for the welding of long seams in rigid p.v.c. fabrications. Two types of new welding machines are available: a semi-automatic welding torch (Fig. 1) and a fully automatic welding machine (Fig. 2).

Basically, both machines are capable of depositing a filler rod into a previously prepared groove between p.v.c. sheets. The filler rod in this case is generally of a triangular section having a cross section which fills the welding groove in one single operation. Welding speed and welding temperature are adjusted to optimum conditions; the fully automatic machine travels on rails whilst the semi-automatic machine has to be guided by hand. Both machines are capable of feeding the welding rod automatically with controlled speed.

The equipment developed for automatic welding is suitable for the welding of straight, horizontal seams (Fig. 3) and straight fillet welds, and in cases where the radius is not less than 20 in., also for the welding of curved butt and fillet welds.

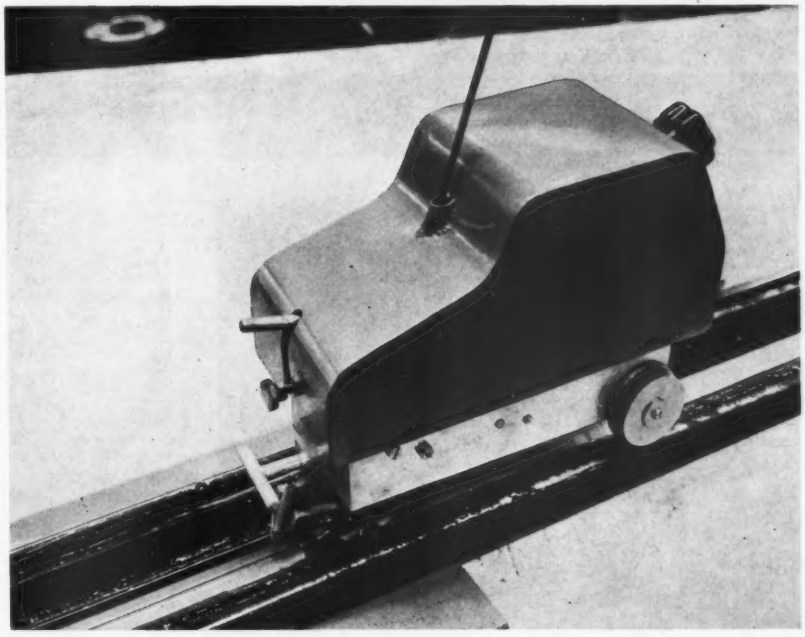
For the welding of fillet welds at the moment the semi-automatic machine should be used (see Fig. 4).

Whilst the fully automatic welding machine is always working on a horizontal plane, the semi-automatic machine can also be used for welding in any other plane. For instance, it can be used for overhead welding. In cases

(Left) Fig. 1. Semi-automatic welding torch.

(Right) Fig. 3. An example of a piece of chemical plant made in p.v.c. by means of the automatic welding plant.

(Below) Fig. 2. Fully automatic welding machine.



* Aug. Schnakenberg and Co.

† These machines are now manufactured in this country and available under the name of "Redimat" from Rediweld Ltd., Crawley, Sussex.

where the weld is not easily accessible or for comparatively short runs, the automatic process is not particularly suitable. In these cases hand welding is still required.

The field of hand welding will become more and more restricted as time goes on, and in the manufacture of circular, square or rectangular fume deuting in p.v.c. sheet, only the smaller cross sections will still be hand welded.

The following example illustrates the economic superiority of the new welding process compared with conventional hand welding. Assuming that a seam of 36 in. length is welded as a straight butt weld with a sheet thickness of $\frac{3}{16}$ in. (Fig. 5), one could neglect the preparation time, i.e. the time for milling the V-slot and preparing the plates, as this is approximately the same for both cases. Hand welding of such a seam will take 35 to 45 minutes, depending on the skill of the welder. In this case, the weld consists of a root layer made on the 2 mm. welding rod and three further runs with 3 mm. filler rods (Fig. 6). Using machine welding, with either semi-automatic or fully automatic machines the same seam can be completed, using a single triangular filler rod, in a time of approximately 3 minutes, i.e. the time is less than one tenth of that for hand welding.

In addition to the increase in welding speed, it should also be noted that a very much better finish can be obtained by machine welding (Fig. 7) than that resulting from the conventional multi-layer hand welding (Fig. 8). Owing to better penetration of the weld material, a strength of up to 80% of that of the sheet can be obtained, compared with an average of 60% for hand welding.

Fig. 4. Welding fillet welds with the semi-automatic machine.

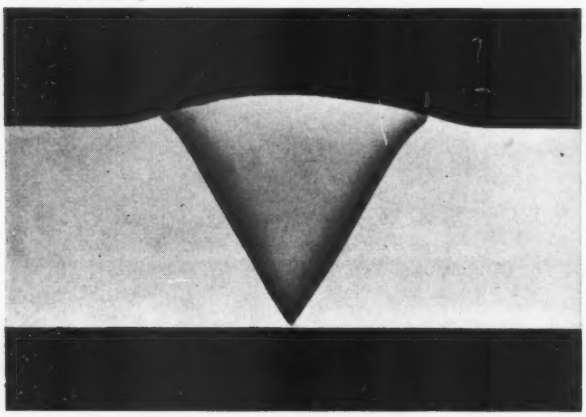


Fig. 5. Straight butt weld.

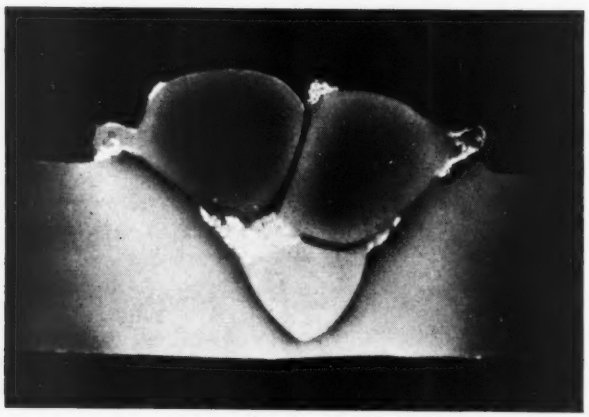


Fig. 6. Hand-welded seam.

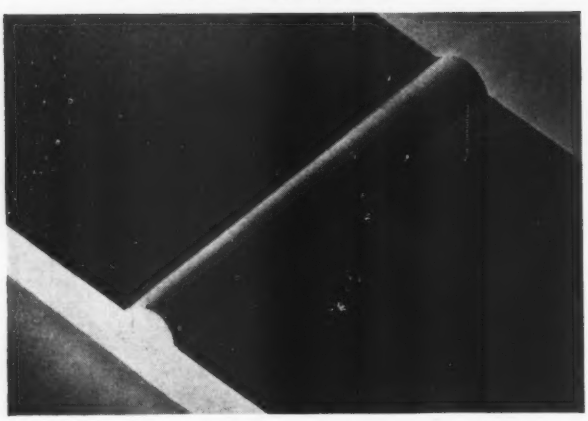


Fig. 7. Better finish obtained with automatic welding.

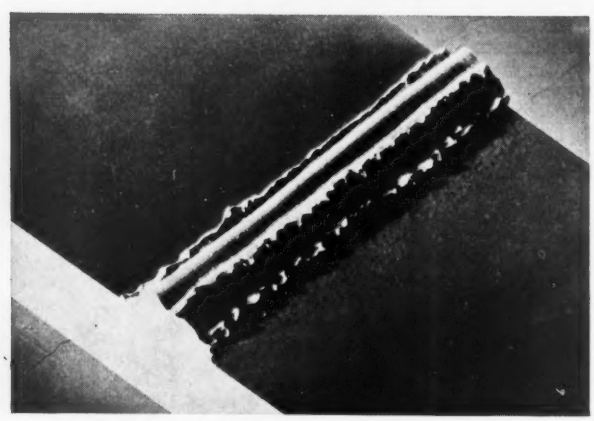


Fig. 8. Conventional multi-layer hand welding.

The Properties and Fabricating of Nylon-11

Part 2—Extrusion

by F. CHAPMAN,* M.A.

Nylon-11 is manufactured in France by Société Organico under the trade name Rilsan, and marketed in the U.K. by Whiffen & Sons Ltd. under the trade name Ralsin. Part 1 of this article was published in the October issue of "Plastics," pages 406-409.

IN a previous article the method of moulding nylon-11 has been discussed. In this article, the extrusion of this superpolyamide is described and a brief description of the properties of the extruded products is also given.

For wire coating the grades of nylon-11 designated by the manufacturer as BEC, BEC.P.20 and BEC.P.40 are most suitable and have been specially fabricated for this purpose. As in the case of moulding powder granules the suffixes P.20 and P.40 indicate increasing degrees of flexibility in the finished product. They can be extruded on most types of extruder, provided certain conditions, which are described below, are met. For the manufacture of film, tubes and bottles, the grades known as BES(A) or BES(N) must be used. BES(A) Grade is a guaranteed food quality material. The S Grades are high molecular weight materials specially manufactured to have a high viscosity when molten, so that they can be extruded on most types of extruder without difficulty.

Extrusion

Nylon-11 granules which are to be extruded must be first dried, so that their moisture content does not exceed 0.2%. This is achieved by drying for four hours at 80° C. It is most important that the moisture content should not exceed 0.2% or the extrusions will have rough surfaces and be brittle, and in the case of wire coating some diminution of electrical properties may occur.

The feed to the extruder must be as uniform as possible and certainly at start-up the screw must not be overfed. It is preferable, wherever possible, to use an automatic feed with a vibrator. The extruder screw must be designed to meet the following requirements:—

1. The length of the screw must be at least 10 times the diameter, and if possible, 15 times the diameter, to ensure a sufficiently long contact with the hot cylinder walls to give a regular melt.

2. The play between the screw and the cylinder walls must be the minimum, and less than 0.1 mm. in order to obtain efficient compression.

3. The ratio of cross sections of the feed and delivery portions of the screw must be designed to give a high compression ratio of at least 2: 6.

In addition the screw must not have too deep a thread, so that only a thin layer of material is carried and so that efficient and uniform heating and melting takes place. The very end of the screw must be smooth, without threads, to avoid turbulence in the material as it enters the extruder head and thence into the die. If this is not possible, then after the screw a torpedo must be arranged to prevent turbulence.

Screws for nylon-11 can be made in hard steel, nitrided steel or carburised steel and must always be polished to a mirror finish.

The two types of recommended screw are shown in Figs. 1 and 2. The first type (Fig. 1) has a root diameter which increases uniformly from feed to delivery sections. The second type (Fig. 2) has a uniform increase in root diameter for the first part of its length. This is followed by a small length with increased root conicity and finally a delivery portion with, again, a root of uniform diameter.

When extruding nylon-11, the extruder must be heated electrically and the heating installation must have a capacity capable of giving temperatures as high as 280° C. if necessary. The extruder barrel should have three distinct temperature zones, the heating of each of which is independently regulated. The feed zone should be maintained at reasonably low temperatures to prevent too rapid a fusion of the nylon-11 and consequent sticking to the screw. The temperatures suggested, therefore, for the three zones of the extruder are:—about 150° C. at the feed, 200–220° C. in the middle, and 205–240° C. at the delivery.

After leaving the screw, the molten nylon-11 should pass through the usual filters. These should be made of stainless steel gauze, say 60–100 mesh. All parts of the extruder head are heated and maintained at a temperature of at least 200° C. Different types of heads are used, depending on the end product being extruded.

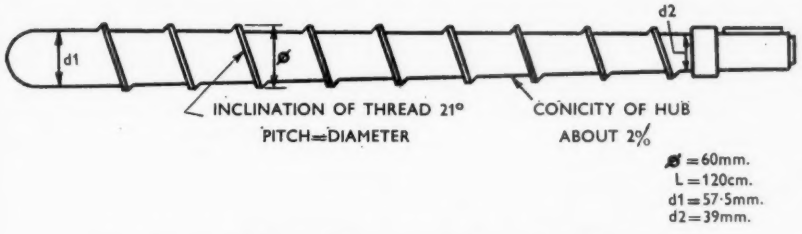
Wire Coating

When coating wire with nylon-11 the recommended arrangement is that shown in Fig. 3. It is particularly important that the head should not have too great a capacity and that it should be designed so that there are no stagnant zones. It must be maintained at a temperature of between 205 and 220° C. and designed to fit closely into the end of the screw, as shown in Fig. 3.

Two types of dies are used; in the first the diameter of the die is somewhat larger than that of the final diameter of coating it is desired to obtain. In this case, the die must be long enough to guide the material for a length of 2½ to 3 times that of its diameter. In the second case, the die is of a diameter substantially greater than that required and the molten nylon-11 is extruded as a tube around the conductor and then applied to the conductor by means of a vacuum. In general the first arrangement gives a better surface polish, the second type a better adhesion and a greater throughput. In all cases the die is heated independently and maintained at a temperature of at least 205° C.

As it emerges from the die, nylon-11 is extremely fluid and readily deformed. It must, therefore, be vigorously cooled as quickly as possible. A cooling bath containing cold water is therefore placed as close to the die as possible. From the time it leaves the die to the time it emerges from the cold water bath the covered cable should not be allowed to come into contact with solid materials. To maintain the coated cable tight and to prevent oscillation, take off equipment should be operated at high tension. On the other hand, however, the final reeling equipment should work at fairly low tension to allow any contraction of the nylon-11 to occur.

Coatings of nylon-11 varying in thickness from 0.05 to 1 mm. can readily be applied. The throughput clearly depends, to a large extent, on the capacity of the extruder, for telephone cables, etc., throughputs as high as 400 metres per minute have been obtained.



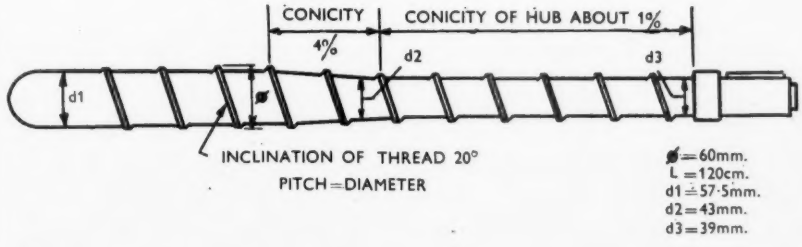


Fig. 1 (above), Fig. 2 (below). Recommended types of screw for nylon-11.

*Whiffen & Sons Ltd.

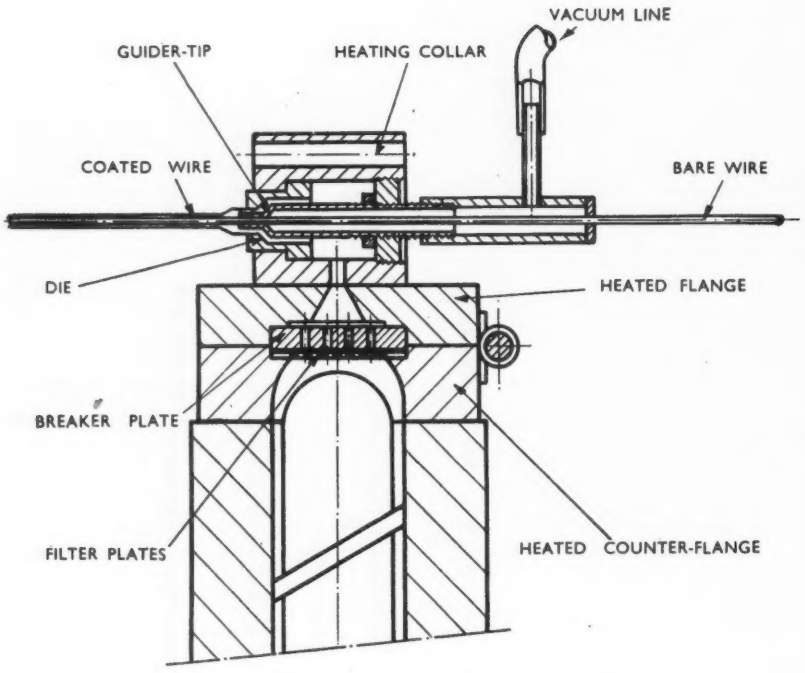


Fig. 3. Recommended die-head for wire covering with nylon-11.

The excellent mechanical properties of polyamides make them particularly valuable for the "armouring" of cable as protection against mechanical damage. The flexible grades of nylon-11 (BEC.P.40) have been most successful for the mechanical protection of electric cables in coal mines; of polythene covered cable in field telegraph installations and of p.v.c. covered cable in aircraft and marine installations.

When considered as primary insulators, polyamides suffer from the defect of absorbing appreciable quantities of water, which in turn reduces their electrical properties. However, nylon-11 is the industrial polyamide with the lowest water absorption. Consequently, it has been, and can be, used as primary insulation particularly in the range of low medium frequencies and voltages. Nylon-11 has been used for windings in motors and solenoids, for aviation equipment and for aerial branch lines. It is worth mentioning that during soldering nylon-11 melts on contact with the soldering iron and soldering can, therefore, be carried out quickly without prior preparation of the wire ends.

Wires and cables insulated with the flexible grades of nylon-11 are entirely suitable for refrigeration equipment as they will withstand temperatures as low as – 70° C. in addition to being resistant to the solvents, gases and liquids normally found in refrigeration equipment.

Pipes and Tube

Nylon-11 Grades, BES(A) or BES(N) are high molecular weight, high viscosity grades which can be extruded on most standard extruders. When the pipe emerges from the extruder die it is then passed through a cold calibrating die, the dimensions of which have been carefully calculated as a function of the thickness of the tube and the speed of extrusion. The pipe is vigorously cooled in a cold water bath and then drawn horizontally on suitable take-off equipment. For pipe of small diameter (up to 5 mm.) the vertical extrusion technique directly into cold water can be adopted without the need for a calibrating die. Above 5 mm. diameter, however, the special horizontal take-off procedure is essential.

Nylon-11 tube is made at present in diameters from 1–80 mm. with wall thicknesses of 0.3–4 mm. The pipe possesses the basic properties of nylon-11, namely excellent mechanical properties, combined with highest chemical resistance.

Welding

Nylon-11 pipe can be welded in exactly the same manner as polyvinyl chloride pipe, i.e. by the use of a hot gas torch. In practice a hot air, or preferably hot nitrogen, torch is used. As welding rod, a rod of nylon-11 of from 1 to 5 mm. thickness is normally employed.

When welding pipe head to tail, it is necessary first to make a bevel on each with an angle of about 50°. The pipes are then placed together and the interstice filled with welded material. The assembly is turned and the welded joint gradually extended round the circumference of the two tubes. The molten nylon-11 accumulates in the depression between the tubes and is allowed to accumulate until it exceeds the thickness of the pipe to some small extent. For "T" joints the same technique can be applied.

Jointing

One of the pipes is first bevelled and forms the male part of the joint. This is coated with mineral oil. The other pipe, which is to be the female part of the joint, is warmed by a hot air torch and then, by means of a wooden mallet, the male is forced into the female part, held in a vice. When the assembly is cold the male part is withdrawn from the female part and the two parts cleaned again. They are both then coated either with a special glue based on nylon-11, or with Araldite 101 plus the appropriate hardener. Finally, the joint is reassembled, the whole heated gently for a short time and finally allowed to cool and set.

Coupling

Nylon-11 pipes can be coupled to each other or to metal pipes and valves, using the normal coupling components employed with rigid polyvinyl chloride pipes.

Bending

Nylon-11 pipe is bent in exactly the same way as rigid polyvinyl chloride pipe, but a certain amount of care must be exercised during the process. The pipe is first filled with sand and the ends closed with suitable stoppers. Then, using a hot air torch, the pipe is heated to about 120–150° C. over a length of about 25 cm. The warm pipe is then bent to shape around a suitable former and allowed to cool in position. During cooling the pipe is sprayed with cold water.

Working Pressure

Nylon-11 undergoes very little cold flow. It operates satisfactorily in the temperature range – 60° C. to 100° C. It is shock proof and unaffected by vibrations. The safety factors applied to nylon-11 pipe are, therefore, much less stringent than those applied generally

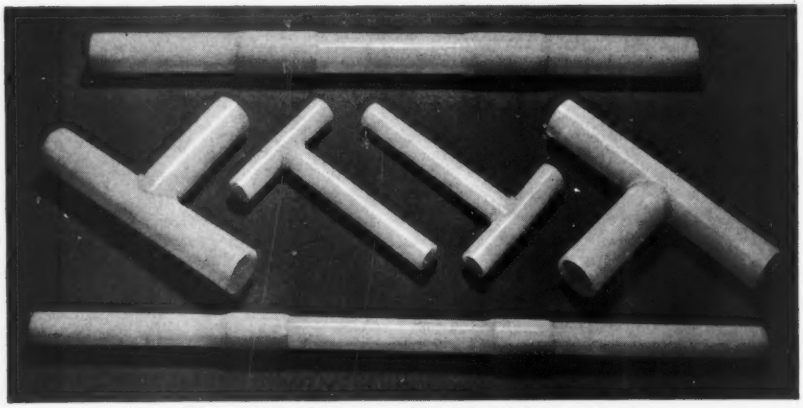


Fig. 4. Extruded tubing and fabricated joints in nylon-11.

to plastic pipe. Consequently, the working pressures of nylon-11 pipes are much higher than those of other plastic pipes. The working pressures for pipe of varying diameter and wall thickness are shown in Table 1.

TABLE 1

WORKING PRESSURES FOR RALSIN PIPE

Diameter (mm.)		Working Pressure (kg./cm²) at		
I.D.	OD.	20° C.	50° C.	90° C.
4.5	6.0	20	16	6
6.0	8.0	20	16	6
8.0	10.0	20	16	4
9.0	12.0	20	12	6
15.0	20.0	15	12	4
19.0	25.0	15	12	4
25.5	32.0	10	8	3
33.0	40.0	10	8	3
42.0	50.0	10	8	3

Tube and pipe made from nylon-11 are finding substantial outlets in the automobile and petroleum industry, as they are particularly resistant to petroleum products, even when the percentage of aromatics is high. In addition, they can be made in flexible grades with the same high chemical resistance.

In the chemical industry, in refrigeration and in the food industry, pipes in nylon-11 have a great deal to offer in so far as they combine chemical resistance with resistance to high temperature and an ability to be steam sterilized when necessary. They are finding increasing uses in chemical works, breweries, dairies and in the food industry generally. Furthermore, as they can be repeatedly sterilized, they are entirely suitable for blood transfusion purposes and in the manufacture of surgical equipment. Of particular interest is the development of the so called K grades of nylon-11 which have been stabilized against boiling water. It is from these grades that pipe suitable for installation for domestic hot water supplies can be fabricated.

Film

Nylon-11 can be extruded, both as lay flat and as flat film but a considerable amount of know-how is necessary to achieve this satisfactorily and efficiently. In general terms, however, it follows classical methods, the flat film being extruded through a T-shaped die and the tubular films through a tubular die.

In the case of flat film, after leaving the die (the temperature of which must be very carefully regulated) the film passes over cooled metal rollers. It is cut to required dimensions and reeled. The thickness varies from 0.02 to 0.3 mm.

Tubular film is extruded vertically downwards, the tube being blown to give thin walls and large diameter. The tube is blown lightly on the inside and cooled on the outside as it leaves the die. The thickness is regulated by the throughput of the extruder and the rate of take off together with the intensity of blow. The circular tube is flattened between two series of rolls and finally reeled. Lay flat film is now manufactured in thicknesses varying from 2/100 to 1/10 mm. and in widths varying from 50 to 400 mm.

So far the lay flat film has been most extensively developed. Nylon-11 film has excellent physical properties, which are tabulated in Table 2.

Fig. 5. Lay flat tubing and films manufactured from nylon-11.

It will be seen that it has a high elongation at break, even when thin, and a very good tensile. It resists folding, tearing and scuffing, is sterilizable and serviceable over large range of temperature. (– 70° C. to 100° C.)

The lay flat film has found its greatest application in food packaging. When made from the BES(A) grade of granules, it is completely food grade and stable, and contains no plasticizers which could migrate. It has excellent resistance to fats, oils and although its water vapour permeability is somewhat higher than that of polythene film, its gas permeability is less.

TABLE 2

Colour	Translucent or coloured
Density	1.04
Breaking Strength (kg/cm²)	700–800
% elongation at break ...	250–450
Heat sealing temperature (°C.)	190
*Water absorption	Less than 1%
†Water vapour permeability	0.01
Chemical resistance ...	Excellent
Inflammability	Self-extinguishing

* After 24 hours immersion.

† g/24 h/m²/mm. thickness/cm. Hg at 25° C.

Film in nylon-11 can be readily heat-sealed both on thermal impulse and high frequency heat sealers, always provided that the necessary sealing temperature, of approximately 180 to 190° C., can be achieved. It allows vacuum packing to be carried out with considerable ease and in addition it can readily be printed or metallized to give a very attractive finish.

The packaging in nylon-11 film of many food products, such as meat, bacon, cheese, olives, spaghetti, ravioli, sausages, ham, fish and cooking oil is now being carried out on an extensive scale. In many instances, the product after packaging can be cooked in the pack, as nylon-11 film withstands boiling water for sufficiently long periods to enable the contained product to be adequately cooked or reheated if it is cooked before packaging.

Another outlet for the film is the packaging of medical and surgical equipment. Such equipment can be sterilized in the pack as the film will withstand 140° C. for 20 minutes, which conditions are normally applied for the aseptic sterilization.

Bottles

Bottles can be blown from nylon-11 using what are now the standard techniques employed for polythene. For this purpose the high molecular weight, high viscosity grades of nylon-11 must always be employed to give best results. The extrusion of the blank can be carried out on a wide variety of extruders. However, very careful control of subsequent conditions is necessary to ensure the blowing of nylon-11 at the correct viscosity. This again demands a specialised know-how. The blowing air pressure should be relatively small and maintained for about 10 seconds. Where transparent bottles are required the mould must be rigorously cooled.

Production rates of four to five bottles per minute can readily be obtained. Because of its high mechanical strength, nylon-11 bottles can be made with comparatively small wall thicknesses, varying say between 2/10 and 8/10 mm.

Bottles obtained from nylon-11 are unbreakable. Made in a food grade product they also can be sterilized and are ideal for pharmaceutical, hospital and domestic use, as well as for blood transfusion purposes, and feeding bottles. They possess all the basic properties of the raw material and can thus be used over a wide range of temperature. They can be stored in refrigerators or immersed in boiling water to heat their contents.

Monofilament

So far in discussing extrusion, the discussion has been confined to the extrusion through a single-orifice die to give tube, film, etc. By extruding molten nylon-11 through a multi-

orifice die very regular continuous filaments can be obtained, which after suitable treatment find application in brush making and weaving. It is not intended in this article to attempt to describe the textile applications of nylon-11 but continuous filament of substantial diameter is manufactured for the weaving of industrial cloths such as filter cloths, car covers, and lightweight luggage.

Filaments for brushes are obtained by exactly the same process and can be prepared either flagged or unflagged in diameters varying from 15/100 to 50/100 mm. These brush filaments can be vividly coloured and repeated tests have shown them to be extremely resistant to wear. Brush filament made from nylon-11 has a high degree of elastic recovery which remains even after soaking in hot water. This property, combined with the general inertness of the material, has promoted its use not only in domestic articles, such as toothbrushes, clothes brushes, hair brushes and so on, but in industrial brushware for cleaning tanks, filter presses, vats and machinery, etc.

Fig. 6. Bottles and other components blow-moulded from nylon-11 tubing.

Conclusions

Nylon-11 possesses all the basic properties of the superpolyamide class of plastics. Consequently, the extrusions and mouldings made from it have excellent mechanical properties and high chemical resistance. The availability of extrusion grades readily converted to tubular film has ensured it a future place in packaging. The ease with which it can be converted into pipe, some grades of which have continuous resistance to boiling water, make it of interest to a wide range of industries. In many cases the full potentialities of the extruded materials have yet to be realised, but judged from the basic properties of nylon-11 it is clear that they have a considerable future ahead.

Optical Materials Development Laboratory

As a result of a survey indicating a need for styling and colour development in optical sheets, the Plastics Division of the Celanese Corporation of America has established an optical materials development group as part of its Technical Service and Application Laboratory. Primary function of the new group is to conduct a continuous programme of colour and pattern development with Celanese Lumarith optical material (specially formulated cellulose acetate sheeting). The optical laboratory will also assist Celanese optical customers with individual problems in styling their lines.

From the standpoint of both frame manufacture and lens insertion fabrication of Lumarith is excellent. Colour possibilities are almost unlimited. Other reasons why Celanese Lumarith optical material has won ready acceptance in the optical field include its colour-stability, durability and low cost.

The following photos trace Lumarith optical material from the Celanese optical laboratory to a finished frame. This particular frame is a two-colour four-layer composite by Victory Optical Manufacturing Co., Newark, New Jersey.

(Photographs by courtesy of the Celanese Corporation of America.)

(Right) Bending spectacle frame to fit the contour of the nose. Frames are softened in the heater (left) and then placed in the bridge-bending block seen in the centre of the photograph.

(Left) Beta ray gauge and hand checking during sheet manufacture.

(Right) Laboratory press for manufacture of sample sheets.

Expansions in the Use of Epoxy Resins

A pictorial account of developments with these resins, extracted from an article by Mr. P. A. Dunn of Aero Research Ltd., manufacturers of Araldite epoxy resins, published in the November issue of our associated Journal "Light Metals."

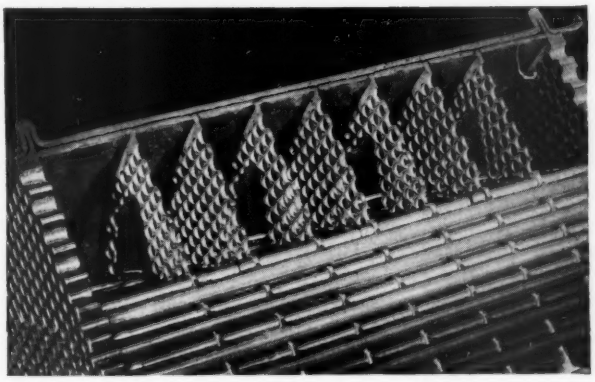
THE photographs on this and the following page record the fast-growing fields of application for epoxy resins in adhesives, surface coatings, castings, and tools. Outside the scope of this article is the resin-glass industry, where epoxy resins are also employed in significant quantities. As the photographs indicate, epoxy resins are versatile in application, due to the versatile characteristics of the resins themselves, as follows: cure is effected without the splitting-off of any volatiles; curing does not require pressure; shrinkage is negligible during cure; epoxy resins have outstanding adhesion to metals and many other materials, have excellent mechanical and electrical properties, and high resistance to many forms of atmospheric and chemical attack; finally, they are stable materials, and can be cured both at ambient and elevated temperatures.

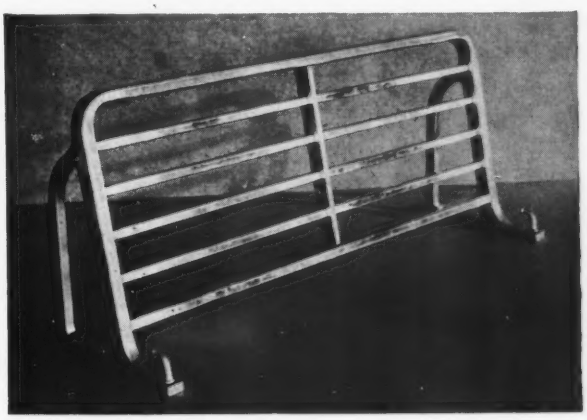
As adhesives, epoxy resins are used to bond metals to metals, metals to non-metals, eliminating potential stress areas associated with riveting. Hence their use in aircraft, railway components, and electrical gear.

As surface coatings, they are used for the internal protection of aluminium collapsible tubes, and for coating components in the textile, brewing and chemical industries, to name only a few major applications.

As casting resins they are used for potting electrical components, for mounting metallurgical specimens, and in many other ways.

In tooling, epoxy resins score on account of low shrinkage, light weight, and speed of manufacture. The aircraft and motor industries find wide application for them as strong and durable tools, often cheaper than their metal counterparts and far quicker to manufacture. Epoxy resins are also finding a wide and growing use in the manufacture of foundry patterns.





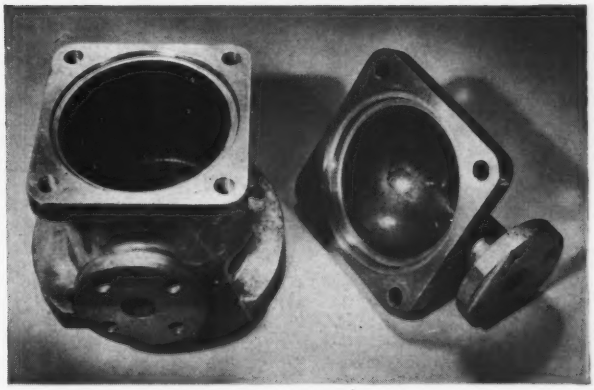
(Above, left). This oil cooler, which operates at temperatures up to 150° C., is bonded with Araldite Type 1.

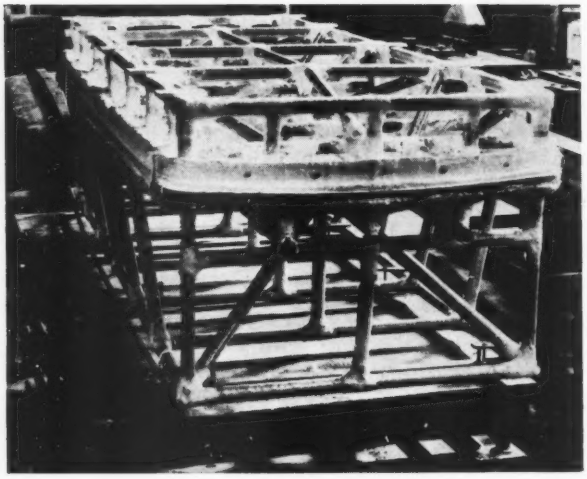
(Above, right). Luggage rack made for the Swiss railways is built of light alloy extrusions and castings bonded with an Araldite adhesive.

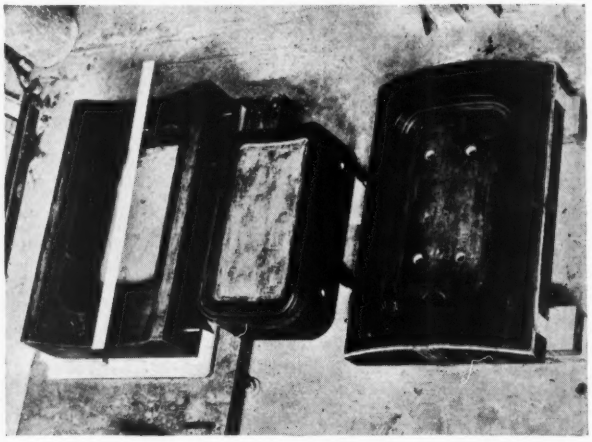
(Left). One of the components of a jet engine protected against corrosion and abrasion with a coating based on Araldite 985E—(de Havilland Engineering Co., Ltd.).

(Below). Aluminium-alloy fitting for a chemical filtration plant by Menrow Ltd., protected with a coating based on Araldite 985E.

Photographs continued overleaf.)







Expansions in the use of Epoxy Resins

(continued from previous page.)

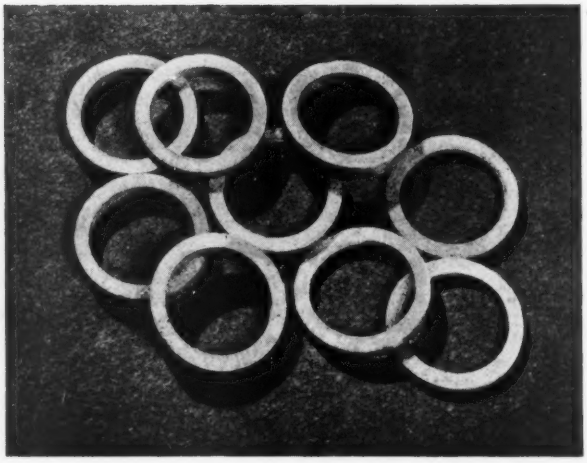
(Top, left). A negative master jig for a vehicle body panel, with a positive jig being built up on it, manufactured with the aid of Araldite resins.

(Top, right). The Araldite resin draw die set for the pressing shown below, left. The rule lying on the pressure pad is 8 ft. long.

(Left). A large light alloy sheet pressing for the door frame of a Vulcan bomber made with Araldite resin press tools by A. V. Roe & Co., Ltd.

(Bottom, left). These collapsible tubes for cosmetics and therapeutic products have been coated with Araldite 985E by Flexile Metal Co., Ltd., London, N.19.

(Bottom, right). Araldite Type I powder formed into pellets to facilitate application.



Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 6d. each (including postage).

B.P. 778,772. Pressure-sensitive sheet. To: United States Rubber Co. (U.S.A.).

Strapping tape having a layer of a water-insoluble rubber-resin type adhesive on a backing sheet of a paper and a film of polyethylene fusion-bonded to the paper. The backing sheet is reinforced by longitudinally embedded glass fibre yarns.

B.P. 778,777. Welding of thermoplastic sheet materials. To: Buchanan Mash & Co. Ltd.

The overlapping edges of sheets are welded by high frequency using a special apparatus in which the heated sheets are pressed between electrodes to a thickness equal to that of a single sheet.

B.P. 778,803. Method and means for treating non-adherent surfaces to render them adherent. G. W. Traver. To: Traver Corp.

The surface of the polyethylene body is subjected to an electrostatic discharge accompanied by a corona discharge. This makes the surface highly receptive to adhesives, bonding material, pigments, ink, flock, decorative matter. The reason why this is so is not yet precisely known.

B.P. 778,817. Glare screens. J. D. Ryan, P. T. Mattimoe. To: Libbey-Owens-Ford Glass Co.

The area of gradually decreasing hue of the anti-glare screen is constituted by a colouring solution printed onto the plastic sheet by means of a printing roll having the desired gradation pattern (add. to B.P. 729,734).

B.P. 778,880. Expanded plastic material. G. P. Lee, E. R. Westmore. To: I.C.I. Ltd.

A major amount of a vinyl chloride polymer, a minor amount of a copolymer of butadiene–1, 3 and methyl methacrylate, and a blowing agent. As thermal insulants, for life-saving equipment, trawl floats, radomes; less rigid expanded material in anti-vibration and shock-proof applications (packings).

B.P. 778,912. Feeding bottle. H. Blan.

A solid walled bottle and a solid walled container with a solid resilient thermal insulation in between. The insulation is removable to enable cleaning and replacement. The teat can be secured in the neck in inverted position to form a closure.

B.P. 778,921. Method of producing artificial sausage casings. To: Wolff & Co. K.-G.a.A. (Germany).

Casings of alginates or alginic acid are given so high a moisture content that they need no after-treatment with water before the filling operation. The casings also contain glycerine to prevent brittleness during smoking of the sausages. They are stored in moisture-proof air-tight wrappings until used on the filling machines (add. to B.P. 711,437).

B.P. 778,921. Plastic solutions for use as dressings for wounds. To: A. B. Bofors (Sweden).

A solution of a vinyl plastic in an organic solvent with or without an innocuous plasticizer, e.g. a polymethyl methacrylate in admixture with a softer resin and, as a plasticizer, castor oil (soya oil, olive oil, etc., or a synthetic plasticizer).

B.P. 779,053. Laminated articles made from moulded materials and metal-reinforced. W. M. Waller, P. H. Waller.

Cups or tumblers, bottles, table mats are made from moulded parts in contact with metal parts preformed as a structure with raised areas and recesses so as to obtain inlay effects.

B.P. 778,953. Method of manufacturing powdery materials comprising a cellulosic material impregnated with a thermosetting synthetic resin. To: N. V. Philips' Gloeilampenfabrieken (Netherlands).

The cellulose fibres are distributed in a solution of a urea-formaldehyde resin (25–40%). The amount of solution is in excess over a predetermined ratio and the excess solution is expressed from the spread out soaked fibres, which then form a coherent layer. This is dried and ground into a fine powder.

B.P. 779,069. Impregnation of fibrous materials with unsaturated polyester resins. K. Herberts (Dr. Kurt Herberts & Co. vormals Otto Louis Herberts) (Germany).

Storable polyester impregnated fibrous materials, which can subsequently be converted into their final form by heat and pressure, are obtained by using a mixture of unsaturated polyester resins, styrene with or without an allyl ester, a surface active inorganic compound (2 to 10 parts to 100 parts mixture) and an organic peroxide compound as catalyst. The impregnated fibres are heated to 50 to 60° C.

B.P. 779,077. Expanded materials from linear polyester and di-isocyanates. To: Hudson Foam Plastic Corp. (U.S.A.).

A light resilient material suitable for being stitched to cloth or other sheet material (interliners, upholstery, padding) by reacting a polyester resin (reaction product of a certain glycol) and a certain aliphatic dibasic acid with toluene di-isocyanate and water in the presence of a tertiary amino catalyst.

B.P. 779,092. Preparation of epoxy resins from aldehyde-ketone condensation products. To: N. V. de Bataafsche Petroleum Maatschappij (U.S.A.).

To improve crease and shrink resistance and washability of textiles by impregnation.

B.P. 779,108. Holders of containers for gramophone records. A. Brody (U.S.A.).

Wear resistant transparent polyethylene envelope for a cardboard record sheath characterized by a pocket for a removable information containing strip. The pocket is sealed to the envelope so that a hinge line is provided for pivoting it out of the envelope.

B.P. 779,135. Rotating holder for filled thermoplastic tubing attached to a packaging machine. L. Rado.

The filled thermoplastic tubing walls are flattened under pressure at predetermined distances and heat welded at the pressure places so that a row of filled and tightly sealed containers is produced which then are cut across the welded width.

B.P. 779,222. Manufacture and construction of crown teeth. B. Berglund (Sweden).

Made from plastic in a single solid piece reinforced by a metal rod and manufactured in its entirety on a factory-scale.

B.P. 779,240. Collapsible container and method for the production thereof. L. Rado.

From a lengthwise folded strip of plastic sheet material provided with a perforation in which a nozzle is inserted separately produced from a less plasticized material. The parts are welded together.

B.P. 779,242. Formation of moulded articles from sinterable materials. M. A. Strivens. To: Standard Telephones and Cables Ltd.

Use of a (moulding) vehicle consisting of a thermosetting and a thermoplastic resin and a plasticizer. The greater part of these materials is removed before the sintering stage.

B.P. 779,247. Coating composition containing polyamides. I. C. Scott, I.C.I.

A stoving composition for electrical conductors comprising a linear condensation polyamide, an alkyd resin and an organic polyisocyanate.

B.P. 779,256. Adhesive tapes or sheets. To: Permacel Tape Corp. (U.S.A.).

On a synthetic rubber basis (copolymer of butadiene and styrene) with an adhesive improving compound present to the extent of 0.1 to 0.2%, e.g. a polyethylene polyamine or a salt thereof.

B.P. 779,278. Production of hollow profiles from thermoplastic synthetic materials. H. Pasche, L. Hermann (Germany).

A (polygonal) steel tube is covered by extrusion with profiled polyvinylchloride. Longitudinal projections, ribs, fins, make the thus reinforced profile suitable for, railings and frames window, door, picture).

B.P. 779,314. Caps for liquid containers. To: N. V. de Bataafsche Petroleum Maatschappij (U.S.A.).

A press-snap type cap with an inwardly dished diaphragm of polyethylene, polyvinyl chloride or similar material. The diaphragm forms a pocket containing a body of gas so that pressure changes inside even large containers (55 gallon steel drum) do not affect the tightness of the seal.

B.P. 779,364. Treatment of plastic materials. L. F. Street. To: Welding Engineers Inc.

The preliminary processing and partial polymerization of thermosetting materials (phenol-formaldehyde, urea-formaldehyde, melamine, etc.) takes place in a machine having a pair of oppositely rotating helical feed members and a resistor part, which provides a restricted passage intermediate the length of the members of a cross sectional area between 1/150 and 1/75 of the square of the bore diameter.

B.P. 779,566. Hardening agents for epoxide resins. To: Chemische Werke Albert (Germany).

B.P. 779,587. Method of manufacturing resistors with a moulded coating of plastic insulating material. G. Canegallo, S.E.C.I. Soc. Elettrotecnica Chimica Italia (Italy).

A resistor and a pair of terminals surrounded by at least one tubular piece of uncured resin material and further resin material are introduced into a mould and the terminals pressed against the resistor before melting and curing the material so that no resin can flow between terminals and resistor.

B.P. 779,685. Moulded plastic container and method of moulding same. R. H. Abplanalp (U.S.A.).

For dispensing aerosols. The nylon container is thicker on one side of the body than on the opposite with a gradual transition towards the thinner side. The outlet nozzle is on the thin

side. When the pressure increases to a dangerous degree a bulge is formed which is easily felt causing the user to drop the container.

B.P. 779,687. Manufacture of plates, sheets and like articles on a basis of high polymeric polymethylene terephthalates. To: Kalle & Co. (Germany).

The adhesion of layers of other substances (paper) to foils of polymethylene terephthalate is exceptionally great if polyacrylic resins are used as anchoring agents.

B.P. 779,728. Dummy warhead for shells and the like, made of pressed plastic material. F. Salvini.

B.P. 779,830. Method of producing synthetic casings. To: Wolff & Co. K.-G.a.A. (Germany).

Vegetable and/or animal proteins are incorporated in a finely divided form in the film-forming solution. The casings are resistant to boiling and prick-proof and they shrink on and adhere to the filling.

B.P. 779,916. Method of lining concrete and like structures. H. Dreithaler (Germany).

A liquid impervious lining by foils or sheets of polyvinyl chloride or polyethylene mechanically anchored in the concrete by integral anchoring elements (ridges, knobs).

B.P. 779,947. Bottles and bottle closures. T. B. Williams. To: Co-operative Wholesale Society Ltd.

A hollow plug within a cap. The plug covers the whole of the interior of the top of the cap. The cap is made of a thermosetting plastic, the hollow plug of polyvinyl chloride.

B.P. 779,961. Ear protector. W. B. Wadsworth, F. R. Poole.

A pair of shells on a head-set type holder. The shells are rigid hollow bodies with an aperture for communication of the ear canal with the interior of the hollow body. For physical protection and, in particular, protection against large sound waves.

B.P. 780,014. Soap holder and applicator. G. M. de May. To: Lionart Ltd.

A polythene shell of lenticular shape with a lateral slit to insert a cake of soap and criss-cross pattern slots on both faces to make contact with the soap inside.

B.P. 780,017. Methods of providing shoes with moulded shoe bottom members. To: British United Shoe Machinery Co. Ltd.

Bonding a dispersion of particles of a vinyl chloride (85–88%) and vinyl copolymer in an equal quantity of dioctyl-phthalate (or compounds of similar properties) to the shoe bottom by heating in a mould.

B.P. 780,065. Manufacture of insulated cables. To: Shardlow Electric Wires Ltd.

B.P. 780,075. Injection moulding machines. To: Crown Machine & Tool Co.

For moulding large plastic articles. The movable platen is first quickly closed using a small volume of fluid through a long stroke plunger. Then a thrust plate is rotated enabling the use of a large cylinder with a very short travel for final closing under high pressure.

B.P. 780,083. Ornamental or display device. G. A. Read.

A wall plate and a vase removably connected to the plate by press studs.

B.P. 780,113. Cases for inkpads, cigarettes, pins and other articles. To: Carl Fr. Brauer G.m.b.H. (Germany).

With spring means for holding the lid arranged in a frontal projection of the base.

B.P. 780,125. Atomizing or spray containers. A. Amigo.

When the walls of the flexible container are squeezed together air is forced into a tube depending from the stopper and mixed with the liquid or powder rising therein so that the tube itself forms the mixing chamber.

B.P. 780,127. Laundry carrier for personal wear. J. E. Wojcik.

With an inflatable stiffened "basket." By deflation the carrier is convertible into a washing apron.

B.P. 780,216. Package. To: Johnson & Johnson (U.S.A.).

For surgical dressings made from two vacuum moulded sheets of rigid transparent thermo-plastic material heat-sealed at the joint.

B.P. 780,286. Fluid tight packing for flasks, jars and the like containers, provided with a screwed cover. A. Bayetto (Switzerland).

A double seal obtained by an insert with a flange between cap and neck and with a lateral interior bulge pressed against the wall of the neck by means of a central projection of the insert pushed downwardly by the cap.

B.P. 780,379. Capsules for sealing containers. C. M. Martin (France).

A hermetic seal provided by a (plastic) capsule with an elastic mantle pushed over the bulge of the bottle neck. The mantle has longitudinal stiffening ribs, which also facilitate moulding, and a tearing tongue.

B.P. 780,399. Reinforcing device for the mouth of clothes pockets and the like of plastic material or cloth. A. Erú, J. O. Sproriero.

A reinforced (by a narrow tape) strip of plastic material is fixed around the inner edges (with sealed corners) of the mouth of the pocket.

B.P. 780,439. Apparatus for the manufacture of hollow articles from thermo-plastic materials. To: L. G. I. Glenn Proprietary Ltd. (Australia).

For polythene, polyvinyl chloride, polystyrene, cellulose acetate mouldings from an extruded tubular body introduced into a two-part mould and expanded by a fluid under pressure. The movements of the platens and mould parts towards each other, admission and cutting-off of the tubular material, pressure and separation of the mould parts are automatically controlled so that on pressing the starting switch, a full cycle of operations is started.

B.P. 780,443. Applicator or swab for cleansing or medicating the human body. R. Steirer. To: K. Bachmaier (France).

A viscose sponge secured to a sheet of absorbent paper by means of a water resistant adhesive and an intermediate piece of resin foil. The sponge is initially compressed to a thickness of 0.5 mm. A number of sheets may be folded together in a zig-zag formation.

B.P. 780,458. Method of manufacturing plastic sheet material with pearl essence incorporated therein. To: Patrician Plastic Corp. (U.S.A.).

Imitation pearl buttons from a transparent unsaturated polyester resin and pearl essence. A layer of the composition in flowable condition is introduced into a pre-heated horizontal drum. The composition contains a peroxide catalyst and the drum is rotated until a non-flowable polymerized layer is formed whereupon the material is removed in a flaccid condition.

B.P. 780,468. Tube-forming means for bag-making machines. To: Ateliers de Constructions Mécaniques C. G. A. Holweg (Germany).

The web is guided into the space between two freely-rotatable frusto-conical rollers set to the desired width of the bag and inclined towards the central axis and with respect to the direction of movement of the web. The web running up in full width and at an obtuse angle into the roller is grasped by guide rods and folded over inwards thus forming a tube.

B.P. 780,479. Thermoplastic compositions and sheeting made therefrom. E. E. Walker, M. P. Shaw, V. W. F. Fisher. To: British Celanese Ltd.

The degradation of the cellulose derivative in sheeting made of cellulose acetate plasticized with trichlorethyl phosphate and containing titanium dioxide, which occurs on exposure to weather, can be greatly reduced by adding a chromium compound together with a polycyclic nitrogenous compound.

B.P. 780,480. Thermoplastic cellulose ester compositions and sheet materials made thereof. E. E. Walker, P. Shaw, V. W. F. Fisher. To: British Celanese Ltd.

The degrading effect of titanium dioxide in combination with sunlight can be counteracted by the incorporation of a finely divided condensation product of formaldehyde and urea or melamine.

B.P. 780,488. Spectacle frames. D. C. Ince. To: Opticraft Ltd.

For use with several decorated attachments.

B.P. 780,508. Trans-illuminated panels. J. W. Strange. To: Thorn Electrical Industries Ltd.

Instrument panels (aircraft) made up of a clear transparent layer, a layer of high reflectivity and an outer layer of low reflectivity and an electrically conducting layer (perforated metal) between two of the layers. The whole structure is rigidly bonded together and a metal plate applied as a backing. The metal plate and the perforated metal layer act as terminals for lamps in apertures of the panel.

B.P. 780,521. Copolymers of unsaturated polyesters. To: Westinghouse Electric International Co. (U.S.A.).

Completely reactive synthetic copolymer resinous compositions for use as insulation for electrical apparatus.

B.P. 780,617. Synthetic edible sausage casings. To: Carl Freudenberg K.G. (Germany).

Sausage casings prepared from collagenous material are hardened by incorporating in the shredded and swollen mass before extrusion an agent selected from the group of dialdehydes and diketones and subjecting the extruded casings to a heat treatment.

B.P. 780,639. Presses for the production of printing blocks and the like from thermoplastic materials. To: Maschinenfabrik Augsburg-Nürnberg A.G. (Germany).

When using starting material in foil form drawn on a calendar the finished block tends to be distorted or buckled by the application of heat for the stamping operation. Therefore dual presses have been proposed one with heated platens, the other with cooled platens. The equipment is effective but expensive. The disadvantage has been overcome by the arrangement of a heatable cover in the press for a preliminary manual operation followed by a full pressure moulding in a cold pressing operation.

B.P. 780,651. Moulding of synthetic plastic material. S. T. Deakin. To: Edison Swan Electric Co., Ltd.

Lengths of polytetrafluoroethylene are manufactured in a trough with closed ends where the loose material is subjected to fluid pressure under a flexible cover. The united length is then removed and set by heat.

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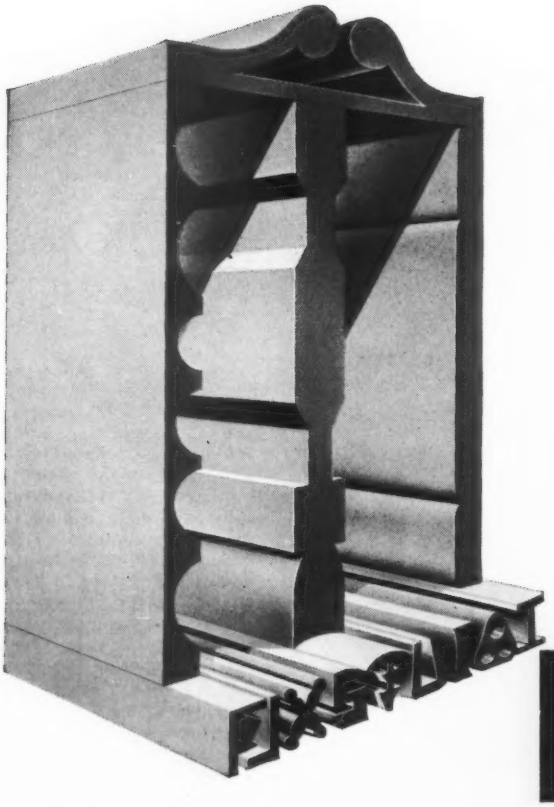

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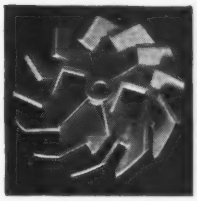

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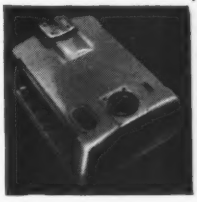

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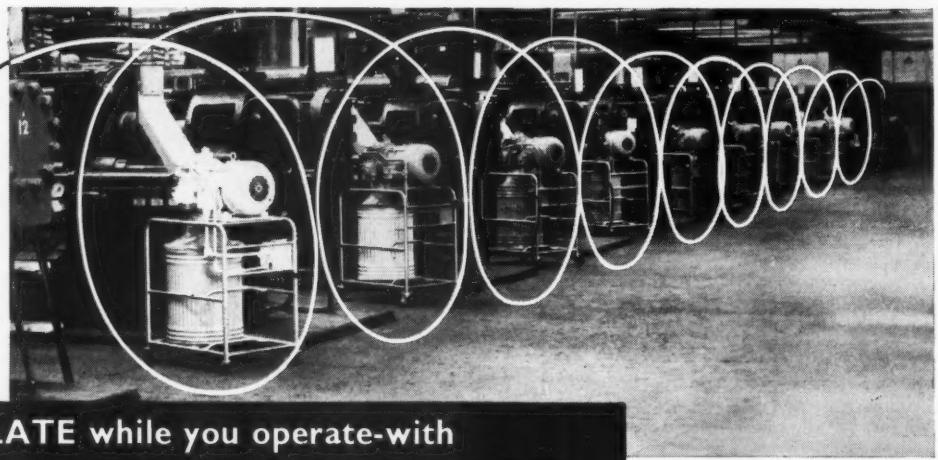

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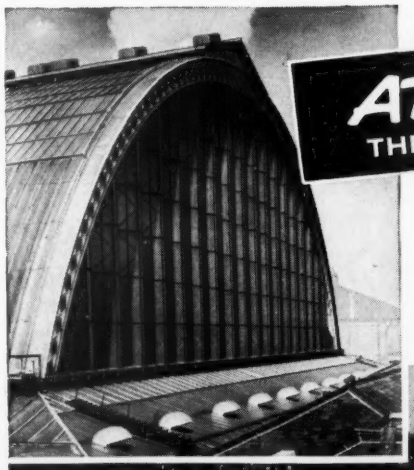

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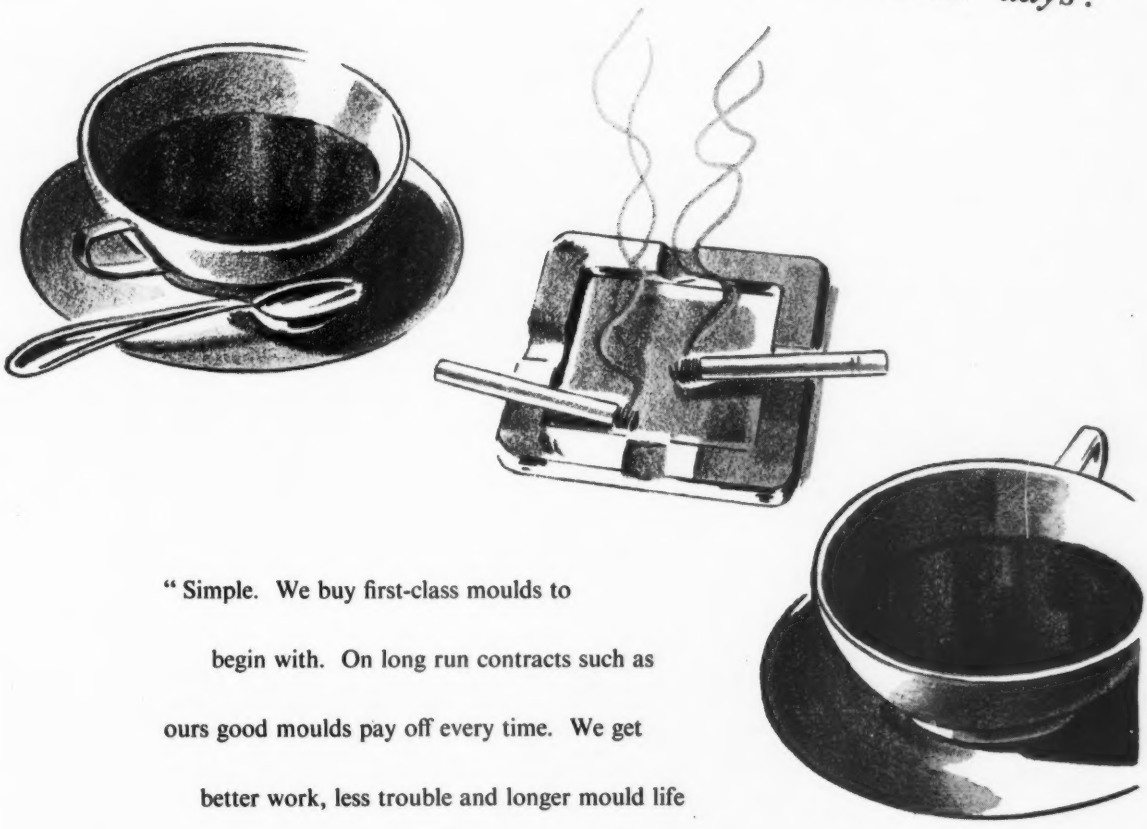

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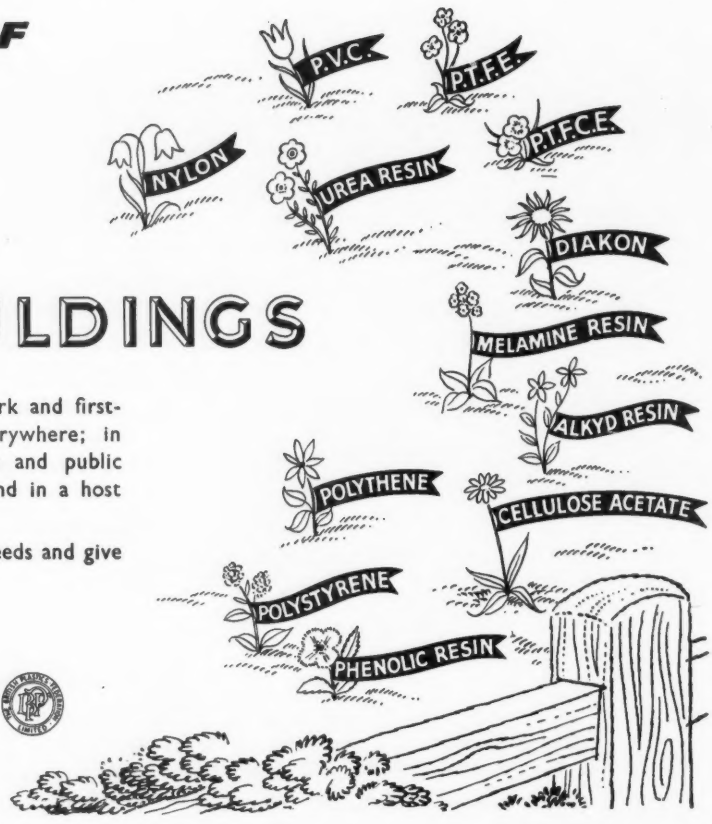

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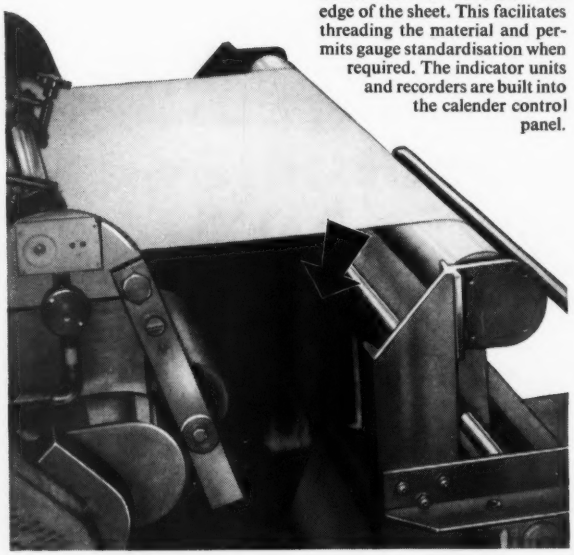

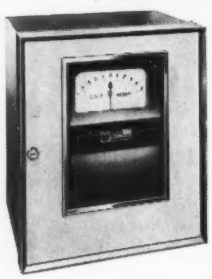

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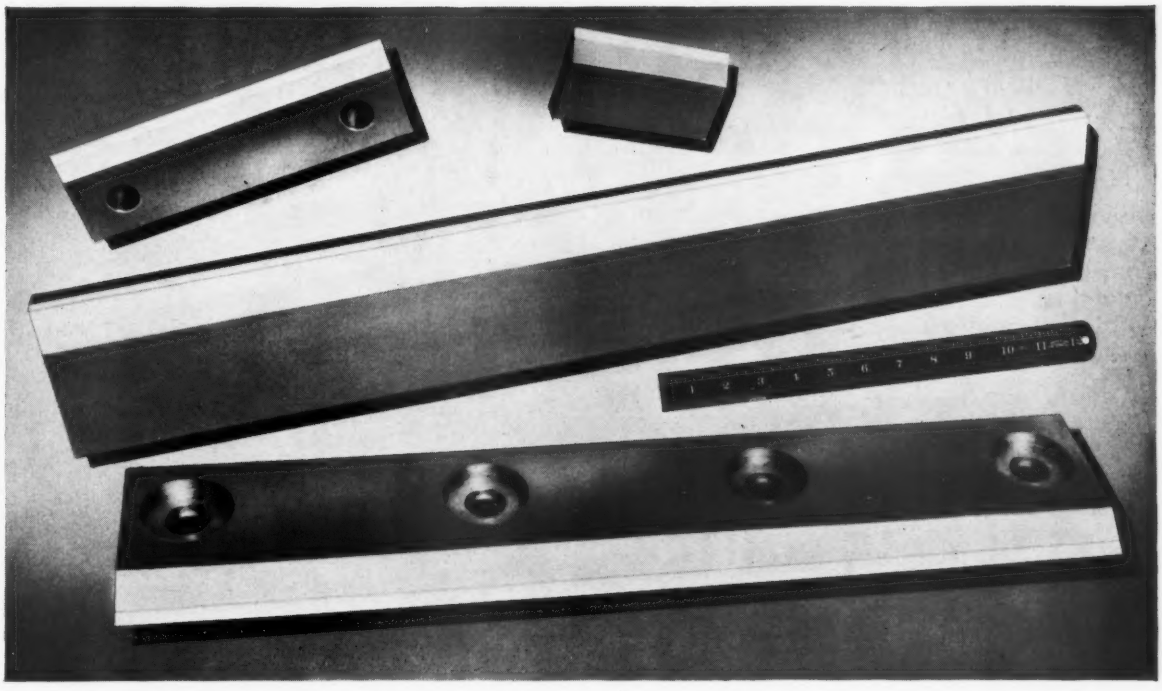

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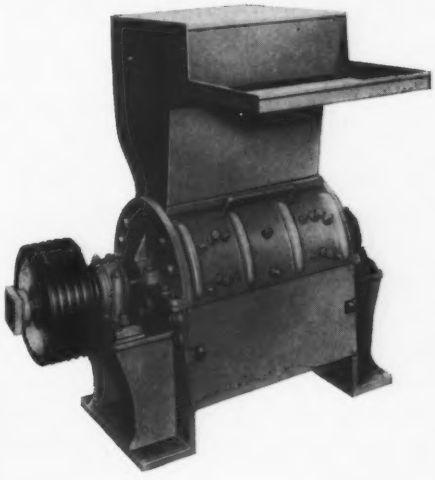

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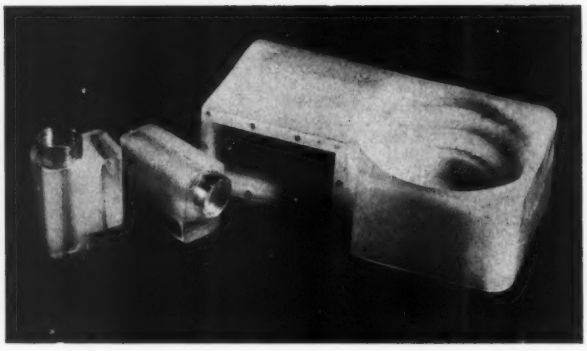

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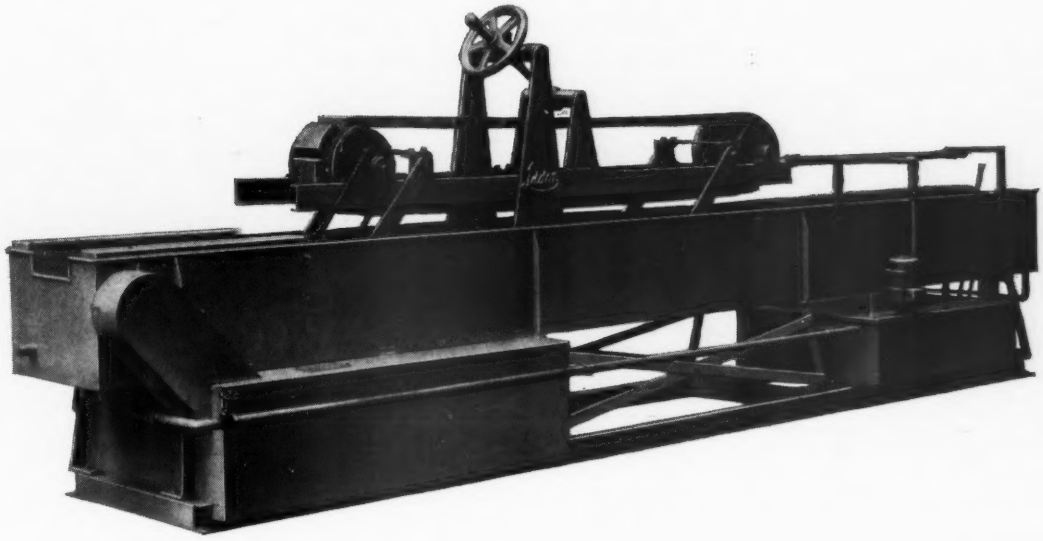

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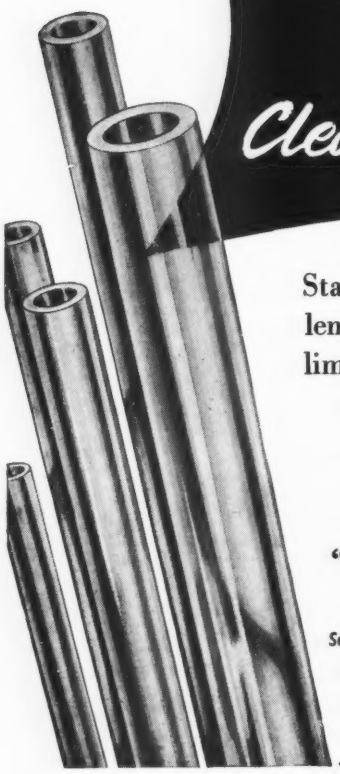

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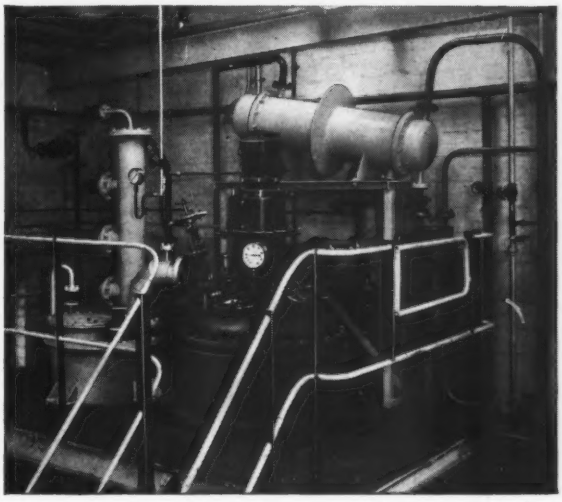

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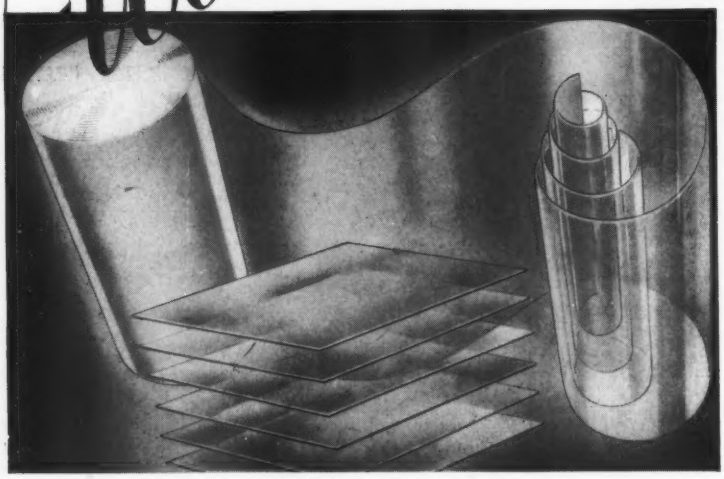

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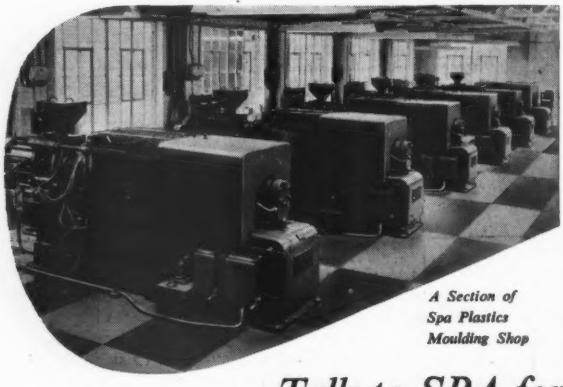

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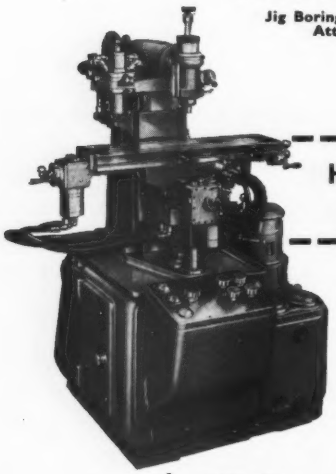

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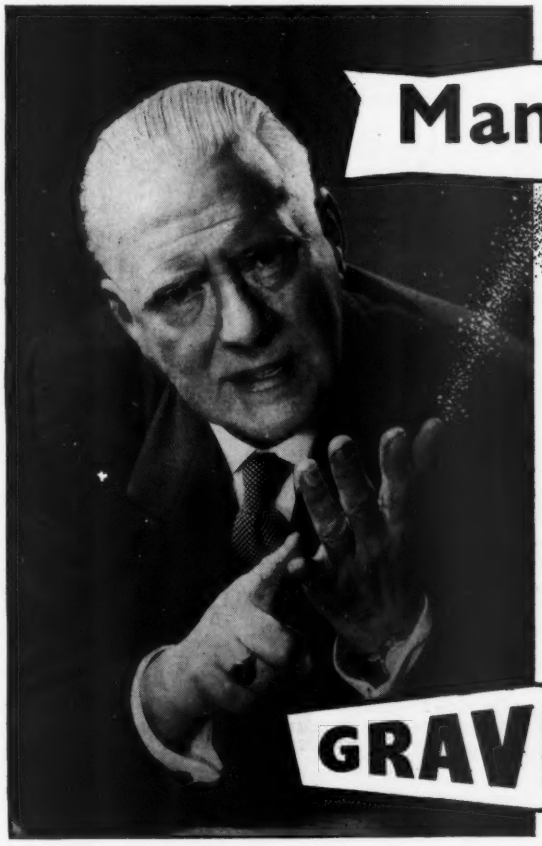

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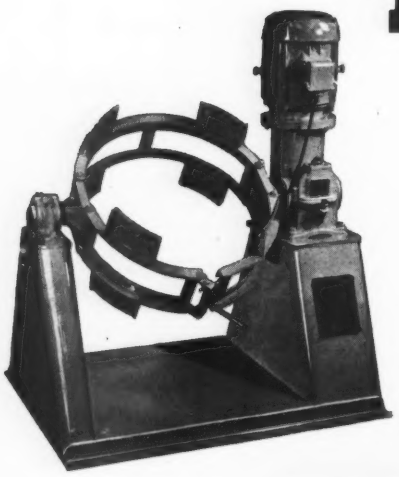

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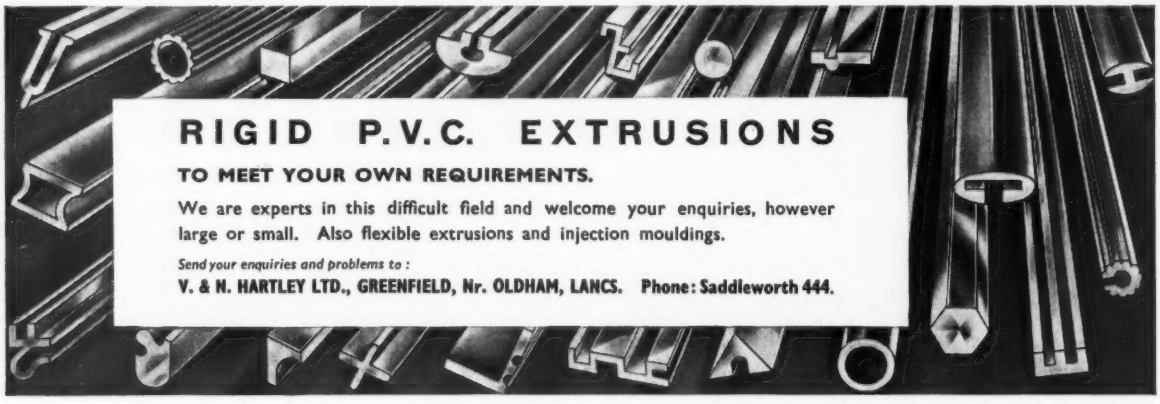

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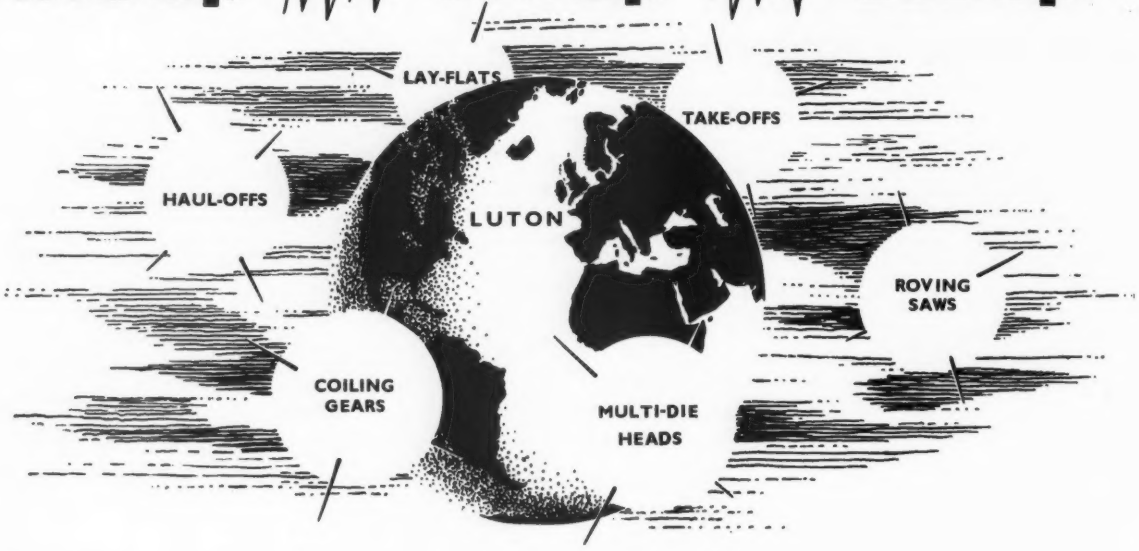

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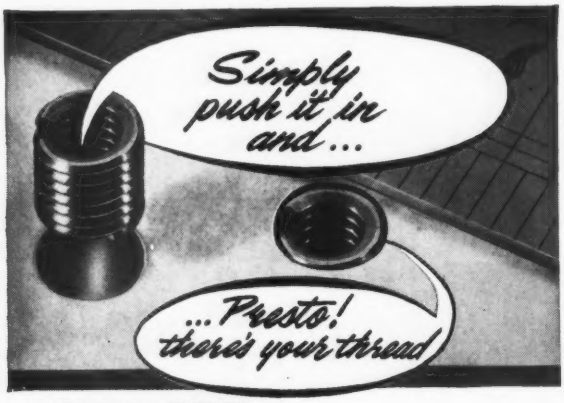

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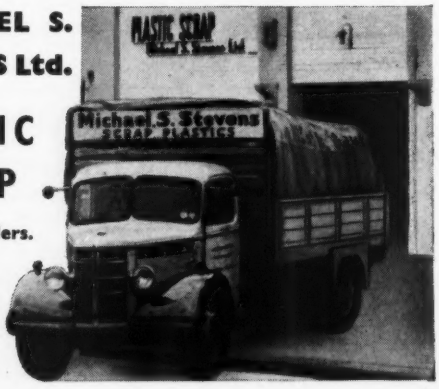

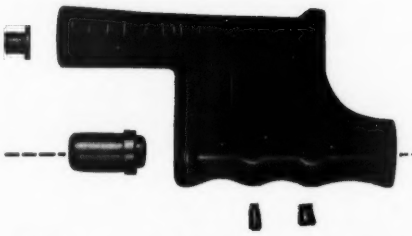

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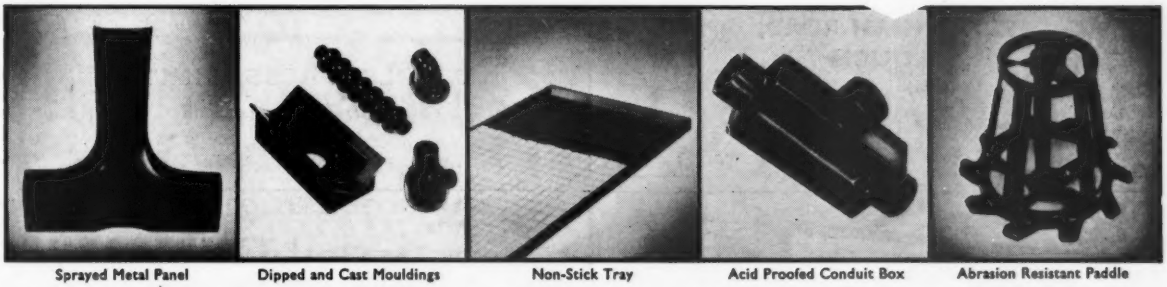

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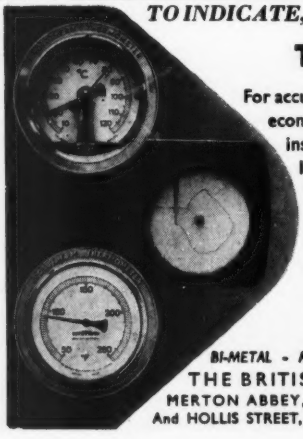

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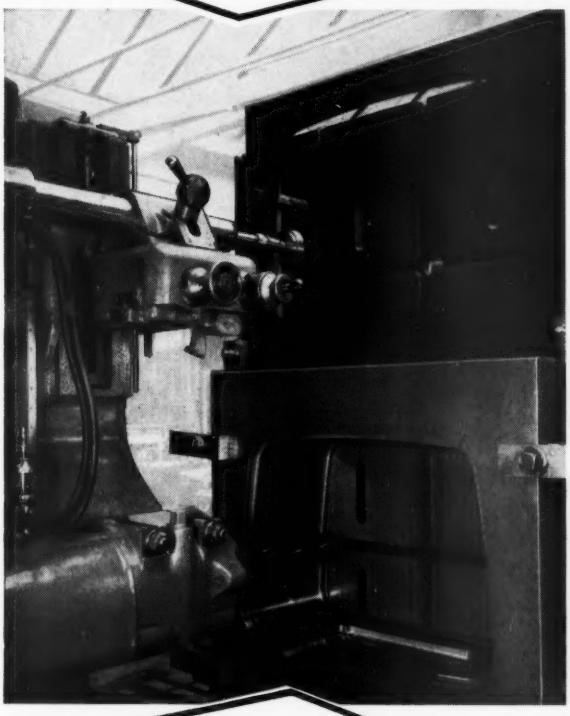

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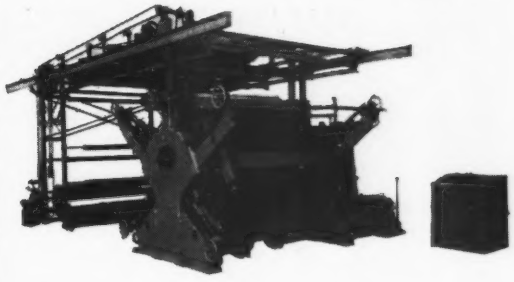

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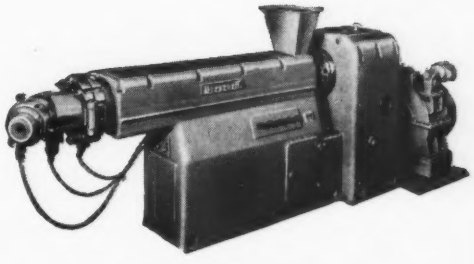

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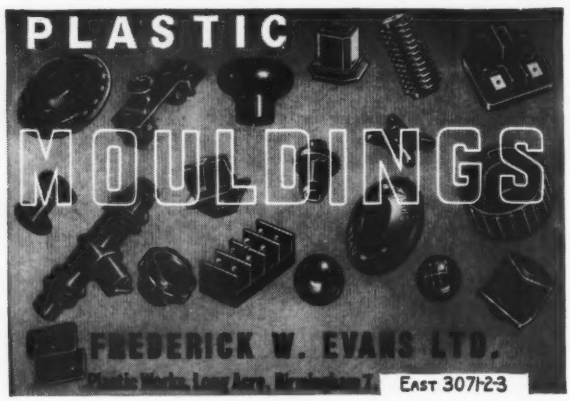

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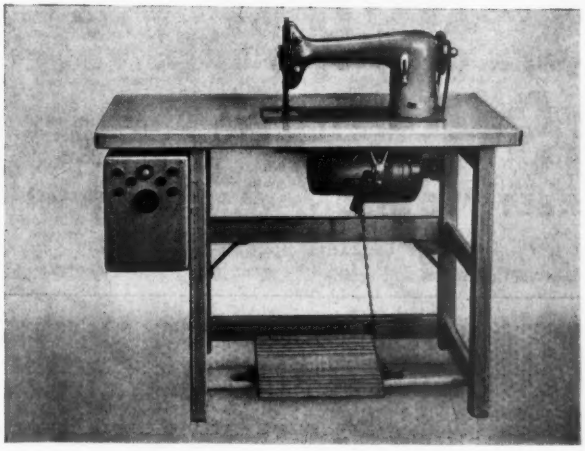

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BAKER-PERKINS UNIVERSAL MIXER. Practically brand new. Working capacity 9 gallons. Stainless steel trough, blades and hydraulic ram. Hydraulic trough tilting mechanism, 40 h.p. motor with fluid coupling. Complete pack with Nash-Thompson Oil Electric Heating to hollow blades, trough and ram controllable to 200° C. Available Cheltenham. Full details on request. Leonard Stace Ltd., Cheltenham. 242-23

NEW high-speed 12 in. Electric Bandsaws for sale. For cutting polythene, p.v.c. rubber, Perspex, cork, leather, cloth, etc., with eight speeds. 400/440/3 phase supply. Illustrations and prices from makers.
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FOR SALE. Standard Compression Moulding Presses by well-known makers, including Bradley & Turton and Hydraulic Engineering. Complete with 1,500 lb. p.s.i. Shop water hydraulic system accumulators and pumps. Range: 20 tons to 1,500 tons. 1–1,200-ton six Daylight Laminating Press, elaulic V.S.G. drive. Daylight, 62½ maximum. Stroke, 26 in. Platen, 49 in. × 62 in. Apply: Ashdowns Ltd., Eccleston Works, St. Helens. 242-13

One only. 7-gallon Bradley & Turton 3-throw Pump complete with motor, starter and guard. £300.
Two only. 100-ton Bradley & Turton Upstroking Presses with gas plattens, less valves and guards. £200.
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Two only. Gas Pre-heaters. £7 10s. 0d. each.
One only. 4,000-ton Hydraulic Press by John Shaw. £4,000.
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THOMPSON 4-COLUMN OILDRAULIC PRESS. With upstroke and Bradley & Turton horizontal pump, for sale. Pressure exerted about 7 tons. Stroke 36 in. Between columns 9½ in. × 4½ in. The head is adjustable 9½ in. × 9½ in. Diameter of ram 3 in. Overall height of press 11 ft. Maximum daylight 6 ft. 6 in. F. J. Edwards Limited, 359 Euston Rd., London, N.W.1, or 41 Water St., Birmingham, 3. 242-48

Machinery, Tools and Plant (contd.)

SIX UNUSED 2,000-TON DOWNSTROKE 4-COLUMN HYDRAULIC PRESSES, by Fielding & Platt. 36 in. ram, stroke approx. 36 in. Daylight 6 ft. 3 in. Columns 11½ in. dia. Table area 61 in. × 42 in. between columns, total pressing area approx. 61 in. × 60 in. Complete with 90 h.p. slip ring motor, switchgear, horizontal pump, ejector ram, side pushback rams, control panel, pre-fill valve and tank. Ideally suitable for multi-platen work. We can quote for making platens if necessary.

SIX—DITTO—but 100 tons capacity. Ram 8 in. dia., stroke 66 in., daylight up to 99 in. Total pressing area approx 30 in. × 25 in. Push back rams fitted. Complete with motorized pump unit and control panel.

TWO—DITTO—but 200 tons capacity. Ram 11 in. dia., stroke 36 in., daylight up to 66 in. Total pressing area approx. 30 in. × 25 in. Push back rams fitted. Complete with motorized pump unit and control panel.

ONE 5 IN. DAVID BRIDGE PLASTICS EXTRUDER. Long barrel type, with variable speed motor, etc. Previously designed for cabling. Little used.

ONE 4½ IN. FRANCIS SHAW EXTRUDER, variable pitch scroll, bored for water cooling. Steam heated cylinder. 30 h.p. drive.

ONE 3 IN. IDDON EXTRUDER, 2 speeds and water cooled scroll. 12 h.p. motor drive.

ONE 2 IN. DAVID BRIDGE EXTRUDER. 3 speed single roll feed. 5 h.p. motor drive.

ONE 32 IN. × 24/18 IN. HEAVY DUTY REFINING MILL by Adamson (U.S.A.). Cast steel frames. Single end geared. Mill only available, but motor and gearbox can be obtained and fitted at extra.

ONE 54 IN. × 20 IN. IDDON 4-BOWL VERTICAL CALENDER, with 90 h.p. variable speed motor, switchgear, gearbox, batching-off equipment and chalking device. Motorized closing gear. First-class order.

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ONE 50 IN. × 20 IN. FRANCIS SHAW RUBBER MILL. Double geared. Mill only.

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BATTERY OF THREE RUBBER MILLS, two 40 in. × 12 in. David Bridge, one 36 in. × 12 in. Francis Shaw. All single end geared. Driven from undershaft with clutches. Will separate. Mills only available, but separate drives can be supplied.

ONE 88 IN. BRUSHING MACHINE. 12 in. dia. brushes. Complete with drive. Useful machine for waterproofers, etc.

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TOTTINGTON,
BURY, LANCS.
Tel. Tottington 123/4. 242-43

MANUFACTURERS of all classes of Spreading Machines, Embossing Machines, Rubber Machinery and Cutting Machines. G. L. Murphy Ltd., Menston, Leeds, England. 242-47

Machinery, Tools and Plant (contd.)

HYDRAULIC PRESSES

300-ton Downstroke Press by M. B. Wild. 20 in. diam. ram × 48 in. stroke, 4 columns 6 in. diam., distances between 36 in. × 23 in. Fully guided table working space 36 in. × 28 in. Daylight 5 ft. W.P. 1 ton sq. in.

250-ton Downstroke Press by Leeds Eng. Ram 14⅜ in. diam. × 20 in. stroke. W.P. 3,360 lb. sq. in. Four 5 in. diam. columns, distances between 31 in. × 16 in. Fully guided moving table working area 31 in. × 30 in. Daylight 34 in.

250-ton Upstroke Press. Ram 18 in. diam. × 15 in. stroke. W.P. 1 ton sq. in. Four columns 5⅜ in. diam., distance between 22½ in. × 18 in. Semi-guided tee slotted table 30 in. × 14 in. × 9¾ in. deep. Daylight 14½ in.

200-ton Downstroke Compression and for Transfer Moulding Press. Double-acting piston type main ram with effective area 11 in. diam. × 12 in. stroke. Fixed and moving tables with working area 30 in. × 21 in. Daylight 36 in. Double-acting piston type ram 6½ in. diam. × 8 in. stroke. Fitted hydraulically operated ejector crosshead.

200-ton Press by Rose, Downs. Glanded ram 16 in. diam. (nominal) × 26 in. stroke. Four 5 in. diam. screwed columns, distances between 20½ in. and 17½ in. Semi-guided moving table, working area 36 in. × 17 in. Complete with Towler pump motorized 400/3/50.

200-ton Downstroke Press by John Shaw. Ram 20 in. diam. × 24 in. stroke. W.P. 1,500 lb. sq. in. Four columns 4⅜ in. diam., distances between 26½ in. × 10½ in. Fully guided moving table working area 26 sq. in.

Four 150-ton Upstroke Hydraulic Presses by Wild. Ram 17 in. diam. × 18 in. stroke. W.P. 1,500 lb. Four 5 in. diam. columns, distances between 25 in. × 15½ in. Fully guided moving table, working area 29 in. × 25 in. Daylight 31 in. Table returned by two pushback rams.

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Phone, Shepherds Bush 2070
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STANNINGLEY, NR. LEEDS.
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HYDRAULIC. Frazer mono-radial pumps, new and secondhand, in stock. Thompson & Son (Millwall), Ltd., Cuba St., London, E.14. East 1844. zzz-158

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WANTED SECONDHAND CALENDER for the manufacture of C.P.V. sheets. Offers to Box P4218, care of "Plastics." 242-12

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WANTED VACUUM METALLIZATION. Edwards 36 in. unit, or similar, in working order. Box P425, care of "Plastics." 242-7

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INJECTION MOULDING MACHINES required; Edgwick 1½ oz. Model H.Y, 4 oz. Peco, Windsor, Lester or Reed-Prentice. Box P4219, care of "Plastics." 242-30

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INJECTION MOULDS required. Redundant tools for production of combs, hair brushes, hand mirrors, bulb bowls, powder bowls, trinket boxes. Must be in first-class condition. Box P4214, care of "Plastics." 242-2

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Tel. 29471. 242-28

Production Capacity Available (contd.)

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16-32 OZ. INJECTION MOULDING CAPACITY available, contact Mr. Henry Freeman, Spa Plastics, Tel. Chesham (Bucks) 81200. zzz-157

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Immediate design capacity available for all types of plastic moulds.
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Polystyrene.
Cellulose acetate.
Polyethylene.
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Polyvinyl butyral.
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FOR SALE.—VIRGIN KEL-F MOULDING POWDER. 500 lbs. Grade 300 Unplasticized, 1,000 lbs. Grade 300 Plasticized below current prices. Box P4223, care of "Plastics." 242-37

RAW MATERIAL WANTED

HERBERT CONNOR LTD., BUYERS OF ALL SCRAP: top prices paid on any terms for POLYTHENE, POLYSTYRENE, ACETATE, NYLON, PVC, DIAKON, PERSPEX, etc., in lump, film, scrap articles, ground and reground forms. Please send samples and details to: 120 Beaufort Park, London, N.W.11. 242-31

WANTED, Polythene scrap. Write to Box P221, care of "Plastics." zzz-132

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POLYETHYLENE MOULDING POWDERS, lay-flat tubing and scrap of all kinds wanted against prompt cash payment. Box P398, care of "Plastics." zzz-147

BROCKWELL PLASTICS LTD., 50 Hollingbourne Rd., S.E.24, will purchase redundant polyethylene scrap of all kinds. We collect and pay cash on collection. Box P399, care of "Plastics." zzz-148

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Raw Material Wanted (contd.)

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WE REQUIRE large regular supplies of Nylon Scrap, Shavings, Lumps and Rejects. Box P332, care of "Plastics." 242-41

WANTED all types of Polythene Scrap. Send details and samples to: Tyruplex, Ltd., 111 High St., N.W.10. Elgar 2684. 242-38

ALL GRADES of nylon scrap required. Box P408, care of "Plastics." 242-44

THERMOPLASTIC SCRAP. We always buy large and small quantities and pay prompt Cash. Send offers to J. W. Nash & Co. Ltd., 27 Beethoven St., W.10. Ladbroke 4655/6/7. 242-40

POLYSTYRENE SCRAP—regular buyers. Michael S. Stevens Ltd., Keswick Road, Putney, S.W.15. Vandyke 3345. 242-46

POLYTHENE SCRAP.—Top prices paid on any terms for any form of polythene scrap in film offcuts, scrap articles, ground and reground forms. Please send samples and details to: Herbert Connor Ltd., 120 Beaufort Park, London, N.W.11. 242-32

REFRIGERATION & AIR CONDITIONING PLANT

FRIGIDAIRE LOW TEMPERATURE REFRIGERATORS. Reconditioned, fitted with new sealed unit, five year guarantee, 49 in. wide × 28 in. deep × 34 in. high, for deep freezing. Storage of ice-cream, frozen food, etc. Price £85 each. Domestic refrigerators; service cabinets and cold rooms also available. A.R.C., 134 Great Portland St., London, W.1. MUSeum 4480. 222-155

SITUATIONS VACANT

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BERNARD WARDLE (EVERFLEX) LIMITED have a vacancy in their Laboratory for a CHEMIST OR TECHNICIAN to investigate problems relating to coated fabrics. Some experience in this field is desirable but not essential.

Initial salary will be in accordance with experience and the post offers good prospects of advancement. Every assistance will be given in the matter of housing.

Applications giving full details should be addressed to the Managing Director, Peblig Mill, Caernarvon, North Wales. 242-5531

DESIGNER-DRAUGHTSMAN required. Experience Injection and Compression Moulds essential. Near London. Details experience and salary Box P388, care of "Plastics." 243-5441

AUTOMATIC TELEPHONE & ELECTRIC CO., LTD.

PHYSICIST.

The Automatic Telephone & Electric Co., Ltd., Liverpool, have a vacancy for a qualified Physicist in their Laboratories at their main works in Liverpool.

Candidates should possess Graduate or equivalent qualifications with some knowledge of Chemistry.

The successful candidate will be expected to carry out investigations on insulating materials, dielectric materials, plastics and other similar topics of applied industrial physics. The work is interesting and it is hoped that the candidate appointed will ultimately be able to qualify for a position of responsibility in the department. Some experience in the above field of work is desirable but not essential.

The post will be on permanent staff with generous contributory pension fund.

Full particulars of age, qualifications and experience may be sent to Personnel Manager, Automatic Telephone & Electric Co., Ltd., Strowger Works, Liverpool, 7. 242-22

SALES MANAGER required for Extrusions Division—Thermoplastics. Experience in the plastics industry an advantage but not essential. Applicants must have good commercial experience and educational background. Age 30 to 40 years. Applications will be dealt with in confidence and should be addressed to: Sales Director, B.X. Plastics Ltd., Head Sales Office, Higham Station Avenue, Chingford, London, E.4. 242-25

Situations Vacant (contd.)

ASSISTANT SALES MANAGER required for Moulding Powder Division—Thermoplastics. Experience in the plastics industry an advantage but not essential. Applicants must have good commercial experience and educational background. Age 30 to 40. Applications will be dealt with in confidence and should be addressed to: Sales Director, B.X. Plastics Ltd., Head Sales Office, Higham Station Avenue, Chingford, London, E.4. 242-26

P.V.C.

QUALIFIED & EXPERIENCED TECHNOLOGIST.

Required to take charge of development and test laboratory dealing with p.v.c. compounds, pastes and related materials. Senior position commanding a good salary with progressive company in pleasant surroundings and having excellent facilities, including pension scheme.

Apply: Managing Director, Vinatex Ltd., Devonshire Rd., Carshalton, Surrey. 242-20

THOMAS THOMPSON & SON, LTD., Hanover Works, Carlow, Ireland, require Supervisor to take charge of production in expanding Fibre Glass Department. Applicants should have sound technical knowledge of design and construction of fibre glass products, together with production experience. The situation is progressive with the expansion of the department. Full particulars of experience, etc., in writing, to the Secretary. 242-19

MAINTENANCE ENGINEER required to take full responsibility under the Chief Engineer for maintaining hydraulic/electric and ancillary plant in efficient working order. Preferred age 28–35, with ability to keep accurate records. Experience of injection moulding machines an advantage but not essential. Salary according to age and experience. Good opportunity for advancement. Superannuation fund. Apply: Production Director, Hughes Brushes Ltd., 32 Ajax Avenue, Trading Estate, Slough, Bucks. 242-14

MANAGER, age between 25–40 years, required to take over expanding extrusion and injection moulding department in North London Plastics firm. Must be capable of supervising both production methods and maintenance routines and advising on technical developments and improvements of plant. Thorough knowledge of extrusion and injection machines essential. Salary £1,000–£1,500 per annum, depending on experience and ability. Pension scheme. Box P4215, care of "Plastics." 242-10

WELL-KNOWN electrical manufacturing company intending to expand in plastic moulding activities in the London area requires Works Manager. Only man with extensive experience in thermoplastic and thermosetting techniques need apply. Write with details of experience to Box P4216, care of "Plastics." 242-11

WORKS MANAGER required for progressive and expanding injection moulding shop. Must have comprehensive practical experience, including negotiation, development, estimating. Write details age, experience, present salary. L. & P. Plastics Ltd., Hawthorn Grove, Penge, London, S.E.20. Syd. 6208/9. 242-x1641

EXPERIENCED FOREMAN urgently required for expanding plastic section, North London area. Eight machines, 3 oz. to 40 oz. With knowledge of plastics, tools and capable labour control essential. Write stating experience and salary required. Box P4217, care of "Plastics." 242-1

UNUSUAL OPPORTUNITY for Chemical or Mechanical Engineer, aged 30–40 years, with practical experience in plastics industry. Development work on new materials and products with scope in works management. Reply giving full details of qualifications, experience, present salary, etc. Box P4213, care of "Plastics." 242-3

REPRESENTATIVE required by London company to sell raw materials to the paint, plastics and rubber industries. Initiative, enterprise and capacity for hard work essential. Write stating details of education, experience and salary required to Box P429, care of "Plastics." 242-5

WORKS MANAGER required for Plastics Engineering factory in West Surrey. Excellent opportunity for highly qualified and experienced man. Salary commencing at £2,000, according to qualifications and experience. Write in strictest confidence to Managing Director, Box P424, care of "Plastics." 242-8

DEMONSTRATOR required by synthetic resin manufacturers for technical service work in the fabrication of resin glass fibre reinforced plastics. The applicant should have considerable experience in organizing and carrying out work, including a knowledge of making patterns and moulds. Salary range £850–£1,000 p.a. Apply: Technical Director, Box P428, care of "Plastics." 243-1026

FOREMAN MOULDER required. Small shop near London. Essential fully experienced. Write Box P4211, care of "Plastics." 244-1028

WE REQUIRE an experienced and energetic man to take charge of our Compression Moulding Shop. Must be capable of obtaining highest possible output from both man and machine. Permanent and well-paid position to the right man. Apply with full details of experience, age and salary required. Seaforth, Watchett Works, Oakhurst Rd., Southend-on-Sea. 243-1029

Situations Vacant (contd.)

TOOLROOM DRAUGHTSMAN, experienced in design of plastics moulds, preferably with artistic leaning, required in South Bedfordshire. Full particulars and salary required to: Box P422, care of "Plastics." 242-x1981

MANAGEMENT SELECTION LIMITED

have been retained to advise on the

appointment of the

SALES DIRECTOR

for a company which is the largest manufacturer in its branch of the plastics industry. Turnover is close to £3 million p.a. and the range of products provides a good basis for expansion. The company has a large capital but profits have been negligible in recent years. The situation was analysed frankly by the new Managing Director who has been appointed to achieve the prosperity that can be expected from the company's position and facilities. His executive team at present lacks a Sales Director. A year's trial will be given before appointment to the Board.

Candidates must have an exceptional record of successful sales management and high level personal selling to industry. University education preferred. Direct experience of selling plastic products to industry would be strong recommendation. Age late 30's to 45.

Salary by negotiation within a range up to £5,000 p.a. Pension, Life Assurance and Disability Scheme. Car provided. Location London.

Please send brief details in confidence, quoting reference LV.512, to E. P. Kelsall, Management Selection Limited, 17 Stratton Street, London, W.1. No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. 242-33

EXTRUSION SUPERVISOR sought by Tuboplastics Limited of Ecuador, who are setting up a Film Extrusion Department and require a practical man of proved ability to take charge. Applicants, aged 23–40 years, should be fully conversant with sheet and layflat extrusion, plant maintenance, preferably in connection with Reifenhaeuser equipment.

Please send full personal details, qualifications, experience and salary required per Air Mail to:—

Tuboplastics S.A., Post Box No. 230,
Quito-Ecuador, S.A. 243-1031

ENGINEERS/PHYSICISTS required for interesting work in materials research. Ability to apply design experience to problems in plastics and metals testing desirable. Minimum qualifications: H.N.C.(Mech.) for Senior Grade; O.N.C. for Intermediate Grade. Laboratory situated in Camberley, Surrey. Five day week, canteen, pension scheme. Applications to Personnel Officer, Box P4222, care of "Plastics." 242-35

EMULSION CHEMIST, experienced, required for progressive Company in West Surrey engaged in the production of inorganic synthetic fibres. Good salary and scope for man with experience and initiative. Write details of age, qualifications and experience to Box P4221, care of "Plastics." 242-36

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Write in the first instance, stating background and salary required to Box P4225, care of "Plastics." 242-49

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ADVERTISING AND PRINTING EXECUTIVE, 10 years in present appointment (not Plastics), offers his services to a company who wish to expand their sales and products through retail outlets. He has devised new sports goods projects suitable for extrusion and injection techniques, for which an established and well-designed trade mark is available. Enquiries, in fullest confidence, to Box P421, care of "Plastics." 242-x2247

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"PLASTICS" is published on the second Wednesday in each month in London, England by TEMPLE PRESS LIMITED, and is registered for transmission to Canada and Newfoundland by magazine post. Application for second class matter pending at the Post Office, New York, N.Y.

EDITORIAL, ADVERTISEMENT, AND PUBLISHING OFFICES.—Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus, London, Telex." Telex: 23839.

BRANCH OFFICES.—Bayliss House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50 Hertford Street, Coventry. Telephone: Coventry 62464. 1 Brazennose Street, Manchester, 2. Telephone: Deansgate 6114-8. 12 Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

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"Plastics" is obtainable from newsagents and bookstalls abroad through the following agents:—EUROPE—Messageries Dawson (S.A.), Paris; Messageries Hachette et Cie, Paris; W. H. Smith & Son, Paris and Brussels. CANADA—Wm. Dawson, Subscription Service Ltd., Toronto, etc.; Gordon & Gotch, Ltd., Toronto. U.S.A.—Eastern News Co., 306 West 11th St., New York 14, N.Y. AFRICA—Central News Agency, Ltd., Cape Town; W. Dawson & Son (S.A.), Cape Town. ASIA—W. Thacker & Co., Ltd., P.O. 190, Bombay. AUSTRALIA and NEW ZEALAND—Gordon & Gotch (A'sia), Ltd.

REMITTANCES.—Postal orders, cheques, etc., should be made payable to TEMPLE PRESS LTD.

COMMUNICATIONS.—All orders, letters and inquiries regarding advertisements, subscriptions, and other business matters should be addressed to the Manager, "Plastics," Bowling Green Lane, London, E.C.1.

Published monthly by the Proprietors, TEMPLE PRESS LIMITED, Bowling Green Lane, London, E.C.1, and printed in England by SIR JOSEPH CAUSTON & SONS, LTD., Eastleigh.

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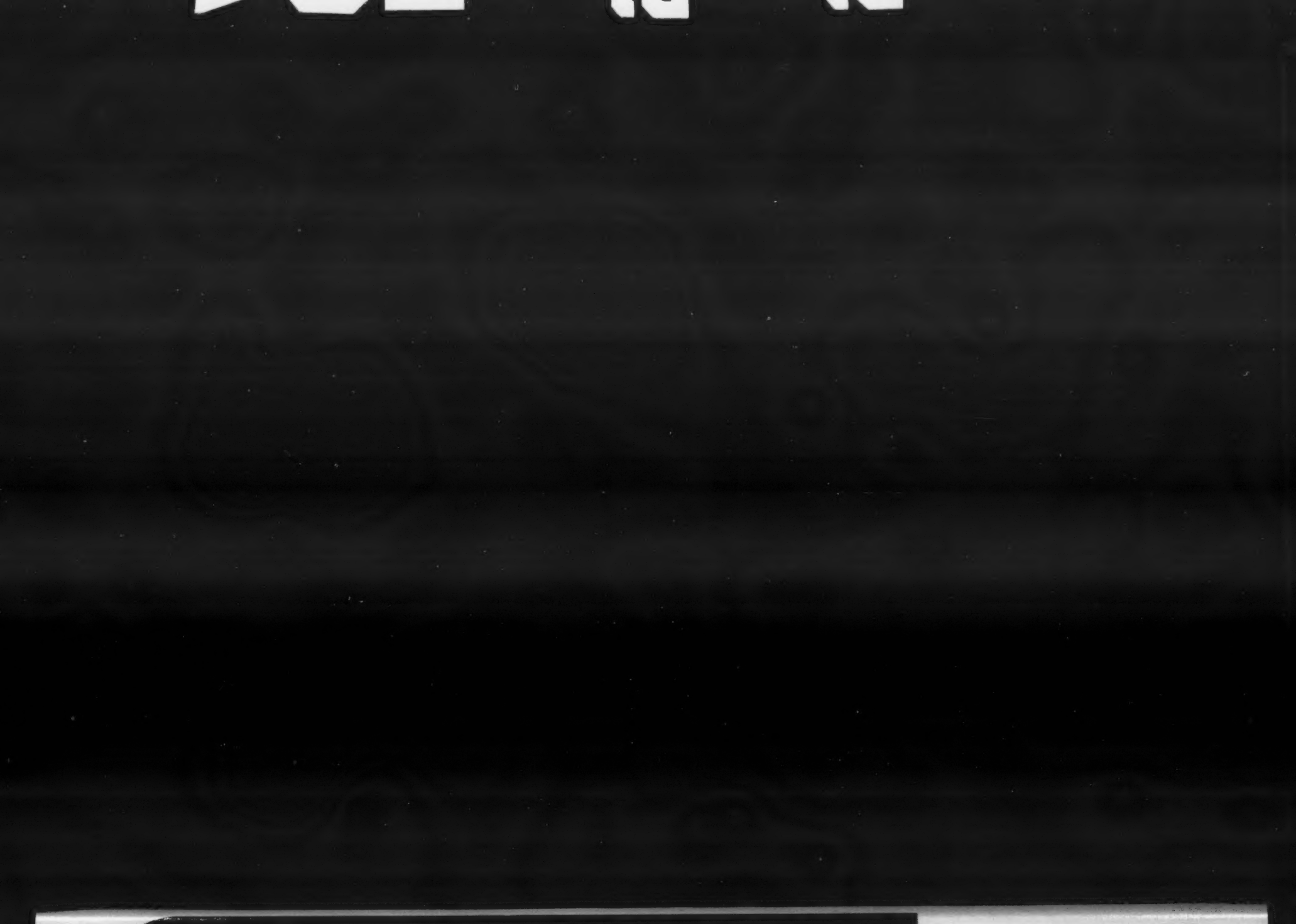
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